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FROM: Director of Life Support

24 March 1969

SUBJ: U-2R LOX System

TO: Commander

1. The following is an attempt, using references maintained in this section, to chronologically list problems encountered in the development of the U-2R LOX System. Recognizing the complexities and the varied nature of these problems, no attempt has been made to completely explain each of them in detail. Only what would appear to be significant developments are documented for your information.

2. The undersigned recognizes that the LOX System in the U-2R is an aircraft installed system and technically not the responsibility of the Life Support Directorate; however, the overall welfare of Project Pilots is our primary area of responsibility, and the reliability of their aircraft Oxygen System must, by necessity, be an area of concern to us.

3. The following sources of information were incorporated into this retrospective study:

a. The Life Support Daily Diary, established in 1965 by [redacted], and maintained since his departure by the undersigned and senior staff personnel within the Life Support Directorate.

b. The Life Support file of official messages relating to the U-2R LOX System.

c. Personal recollections and notes of Life Support personnel and other project personnel who have been involved in these LOX problems.

d. Copies furnished this office of interoffice communications by LAC personnel dealing with LOX problems and meetings.

4. EARLY PLANNING FOR U-2R:

The earliest mention in our records of a LOX System for the U-2 was noted in the Life Support Daily Diary on 4 Jan 66. [redacted], in discussing a full pressure suit for the U-2 with [redacted] predecessor at Hqs) urged they consider LOX rather than gaseous Oxygen System for decreased weight.

On 28 Apr 66, [redacted] noted in the Diary that he attended a WRSP-IV staff meeting and "U-2R purchase looking good, with full pressure suit, LOX, zero-zero seat, etc.,".

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On 16 Aug 66, [ ] in a meeting with [ ],  
[ ], recommended "dual liquid  
Oxygen Systems" for the U-2R. This meeting was held locally  
prior to the Article Configuration Meeting to be held at Hqs  
on 17-18 Aug 66.

On 22 Aug 66, [ ] noted in the Diary that in a tele-  
phone conversation with [ ] (LAC), they discussed  
the fact that Mr. Kelly Johnson had decided to go to a dual  
Oxygen System in their full pressure suit feasibility tests  
for the U-2R. [ ], in a telephone call to [ ]  
on 23 Aug 66, confirmed that the dual Oxygen System for the  
U-2R originated with [ ].

On 24 Aug 66, [ ] noted that [ ] and Mr.  
[ ] from the Firewel Co. (now ARO) visited WRSP-IV  
to "discuss dual vs single Oxygen System for full pressure  
suit" with [ ] Firewel Tech Rep).

5. U-2R COCKPIT MOCKUP MEETING:

[ ] (In 15342 - 22 Nov 66 - Atch 1)  
established the agenda and attendees for the first U-2R meeting,  
including cockpit mockup review for concerned parties. This  
meeting was held at LAC on 29-30 Nov 66. [ ] notes  
from this meeting do not mention the LOX Systems; however,  
[ ], who also attended this meeting, recalls that Mr.  
[ ] (LAC) had a display set up showing two LOX con-  
verters in the wheel-well of the mockup. [ ] recalls  
that [ ] stated that the U-2R (Model 351) LOX System  
would be identical to the SR-71 system (two redundant 10 liter  
LOX converters).

## 6. [ ]

There is no further mention of the U-2R LOX System in my  
records until the LAC assembly and flight test program began  
in Hangar #3 at North Base on 14 Jul 67. This program was  
called [ ]. Prior to their first flight of a U-2R  
on 28 Aug 67, [ ] (ARO Tech Rep) and [ ]  
(David Clark Co. Tech Rep) were assigned to WRSP-IV from  
[ ] to help support [ ].

[ ] recalls that the only WRSP-IV Life Support input  
into the early stages of [ ] was assisting [ ]  
[ ] (LAC) in pilot suiting and delivery  
to the aircraft. No WRSP-IV personnel were allowed in [ ]  
[ ] briefings or debriefings.

[ ] further recalls that there were LOX System and  
air-conditioning problems with the U-2R "from the first day  
of flying by [ ]. This information was obtained from

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the ARO Tech Reps and from verbal reports from the LAC pilots.  
 [redacted] personally recalls ground and inflight aborts by  
 [redacted] due to LOX System problems.

[redacted] also recalled that on one occasion, [redacted] 25X1  
 [redacted] (Chief, Engineering, ARO) advised LAC that there was 25X1  
 not enough heat exchanger in the U-2R LOX System. [redacted] 25X1  
 apparently advised them to lengthen their present heat exchanger  
 lines or add supplemental heat to the present lines. The Life  
 Support Diary on 2 Feb 68 shows [redacted]' notes from a staff 25X1  
 meeting where it was announced that "the 718T is being ducted  
 (air) to warm the LOX lines - what happens if 718T fails will  
 be evaluated by LAC".

[redacted] (LAC), in his memo to [redacted] (LAC) 25X1  
 on 24 Sep 68 (Atch 13), acknowledges in the second paragraph  
 the early problems with the U-2R LOX System.

One example of [redacted] LOX problems is documented in 25X1  
 the Life Support Diary on 29 and 30 Nov 67. [redacted] notes 25X1  
 that in Nov 67, [redacted] (LAC) cancelled a flight because of 25X1  
 a high pressure light on the LOX System. [redacted] (LAC) tele- 25X1  
 phoned [redacted] requesting the assistance of [redacted] 25X1  
 [redacted] ARO Tech Rep). After discussion of the problem by 25X1  
 conference call between [redacted]  
 (ARO), [redacted], it was determined that Mr. 25X1  
 [redacted] presence was not required. [redacted]' notes reflect 25X1  
 that [redacted] (Hqs) apparently sent a message to Hqs  
 stating that no ARO Tech Rep was available at Edwards or Los  
 Angeles, and the flight was cancelled.

#### 7. WRSP-IV LIFE SUPPORT RESPONSIBILITIES: 25X1

At an AGE meeting on the U-2R LOX System held at North  
 Base on 17 Nov 67 (attended by [redacted])  
 [redacted]

"Field service concept (agreement reached) Firewel Tech  
 Reps will do maintenance on Life Support and aircraft LOX  
 equipment, but will not be responsible for removal or replace-  
 ment in aircraft."

"Director of Materiel will come up with joint operating  
 procedure for LOX equipment maintenance and LOX carts." 25X1

"NOTE: Firewel LOX instruction----LAC maintenance crews  
 invited to attend. [redacted] will coordinate with [redacted]."

#### 8. SR-71 SEAT KIT QD PROBLEM:

On 5 Dec 67, [redacted] notes in the Diary that in a 25X1  
 telephone conversation with [redacted], he was informed 25X1

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that the QD carrying the oxygen leads to an SR-71 seat kit (similar QD in U-2R) had separated at a cabin altitude of 29,000 feet and almost caused loss of SR-71 and two occupants.

Subsequent to this incident, there were several conferences between WRSP-IV Life Support, Hqs Life Support, [ ] LAC, and ARO, and finally a fix for the U-2R was agreed upon.

25X1

On 20 Dec 67, at the conclusion of a conference at ARO, Buffalo, N.Y., about the above QD problems, [ ] stated "SR and 351 have different requirements and should not be combined in seeking a solution. SR cabin max. 26,000; 351 cabin max. 30,000 - time of useful consciousness 1 min. vs 4-5 min. Also 351 cannot make rapid emergency descents..."

25X1

9. LAC LOX TRAINING FOR WRSP-IV:

On 21 Dec 67, [ ], as previously agreed upon in section 7 above, scheduled training sessions for WRSP-IV [ ] personnel to be conducted by LAC (Atch 2).

On 18 Jan 68, [ ] (LAC LOX engineer) presented a lecture in Hangar 3 on the U-2R LOX System. [ ] attended, and some of his notes are of interest.

25X1

"Two 10 liter converters. Expect to use no more than 1/2 to 2/3 of available supply."

"At 35,000 feet, 55-hour use time (heavy excess)."

[ ] --- "We should not have any moisture problems in this aircraft except those we bring on ourselves."

10. On 19 Jan 68, [ ]' notes reflect that the first U-2R flight by [ ] occurred. The pilot was [ ]

25X1

11. LOX SERVICING PROCEDURES:

[ ] noted in the Diary on 19 Feb 68 that: "Blow out discs in MA-1 cart for Hangar #3 replaced on two occasions. They are filling aircraft at 45 psi - T.O. recommends 30 psi."

On 20 Feb 68, [ ] noted: "Telecon from [ ] (LAC). He stated that T.O. on cart and [ ] (ARO) both state that 40-45 psi O.K. for filling U-2R LOX converters."

25X1

25X1

[ ] notes reflect that he then called [ ] (ARO), who stated that 30 psi was correct, both in the T.O. and in the ARO info sheet provided with the LOX converters. [ ] corrected [ ] gave this information to [ ]

25X1

25X1

25X1

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Further comments on LOX servicing procedures for U-2R will be included in later comments in this memo.

12. [ ] reported to duty at [ ] on 22 Apr 68.  
[ ] on 31 May 68.

13. EARLY [ ] U-2R LOX PROBLEMS:

The first record of a U-2R LOX problem by [ ] comes from [ ] records. On 28 May 68, there is a note that the #2 LOX System in A/C 056 experienced "excessive vent" during a flight by [ ].

My Daily Diary on 2 Jul 68 reflects my note that: "1600: Informed by [ ] in A/C 053 at altitude apparently had frozen LOX line system #2. Problem corrected itself with descent."

Diary, 3 Jul 68 (Self's note): "1600: Today, [ ], flying A/C 056, had fluctuating LOX pressure at altitude and aborted." [ ] records for this flight show that the pressure in #1 system went from 0 psi to 125 psi on six to eight occasions. My notes continue: "[ ] consulted about seriousness of this problem. ARO feels problem in aircraft of inadequate heat exchanger for converter. [ ] states problem is moisture in LOX."

[ ] (Out 53227 - 3 Jul 68 - Atch 3) brought our concern about the LOX System to the attention of Hqs.

[ ] (In 27164 - 5 Jul 68 - Atch 4) voiced Hqs concern over [ ] LOX problems. [ ] (In 27171 - 5 Jul 68 - Atch 5) added U-2R LOX problems to the agenda of a previously scheduled meeting at LAC on 22 Jul 68.

[ ] (In 27175 - 5 Jul 68 - Atch 6) stated that the problem was moisture in the oxygen. This same message also instructed us to double LAC established purging time.

On 8 Jul 68, the undersigned was informed by [ ] that the individual who had performed the moisture check on the aircraft on 3 Jul 68 had incorrectly performed the check. Re-check using correct procedure had revealed that the subject oxygen was within acceptable limits, and the conclusion reached that moisture was the problem (Atch 6) was a "red herring". [ ] further advised that Kelly Johnson had called a "high level" meeting at LAC today to discuss LOX problems.

Further notes of the undersigned in the Diary of 8 Jul 68 show:

"0930: Discussion with [ ] about LOX problems. My advice to him:

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(1) U-2R restricted to low altitude flights until fix obtained.

(2) If fluctuation of either Oxygen System occurs, pilot to pull green apple and descend to cabin altitude of 10,000 feet.

(3) If both systems act up, immediate descent to actual altitude of 10,000 feet and land ASAP.

(4) Requested that pilots be rebriefed on above procedures."

25X1 "1100: [ ] back about results  
of meeting at LAC. They have decided to pull LOX converters  
written up in 056 and 053 and ship to LAC today for temperature  
25X1 checks to try to duplicate problem. May also pull converter  
25X1 from 052. [ ] recommends only low flights until fix  
obtained. [ ] questioned about type of purge newly in-  
stalled converters will get - his answer was '22 minutes with  
oxygen as per our instructions'. ([ ] at ARO says inade- 25X1  
quate)."

25X1 At the request of ARO, [ ] ARO Tech Rep)  
accompanied the LOX converters to LAC for the tests (Mr.  
[ ] gave permission). 25X1  
25X1

25X1 The Diary on 9 Jul 69 reflects that [ ] informed [ ]  
that the converters checked out O.K. at LAC. [ ] further  
25X1 stated that LAC had apparently decided to obtain SR-71 heat  
25X1 exchangers for U-2R LOX converters.

25X1 [ ] further informed [ ] on 9 Jul 69 that LAC had  
discovered that the U-2R only had 19 feet of heat exchanger  
tubing and LAC specifications required 25 feet minimum.

25X1 On 10 Jul 69, the Diary reflects my notes that [ ] 25X1  
had apparently informed [ ] that LAC was going to  
add 6 - 8 feet of heat exchanger to present U-2R LOX System  
25X1 and they (LAC) feel this will solve problem. LAC also has  
decided to go to two-hour cold purge of Oxygen Systems.

[ ] (In 27332 - 12 Jul 68 - Atch 7) confirmed  
that the converters pulled on 8 Jul 68 were satisfactory. This  
message also confirmed that the U-2R heat exchanger tubing was  
shorter than specifications and that approximately eight feet  
additional would be added. Further, this message again changed  
purge procedures to one hour at 50 psi with dry ambient oxygen  
and stated that hot purging was being investigated. Finally,  
this message stated that LAC had been unable to identify any  
component malfunction which could have caused the incidents,  
and that moisture was under suspect.

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[redacted] (In 27455 - 18 Jul 68 - Atch 8) cancelled the 22 Jul 68 meeting at LAC.

Staff meeting notes by [redacted] on 18 Jul 68 reflect that [redacted] discussed the addition of eight feet of tubing to the heat exchangers which was in progress at [redacted].

[redacted] on 22 Jul 68 that the meeting at LAC would probably be rescheduled for 6 Aug 68 to discuss U-2R Air-conditioning and LOX Systems.

On 22 Jul 68, [redacted] to set up a meeting in [redacted] office on 23 Jul 68 for [redacted]. Subject: "U-2R Pressurization/Cooling".

On 23 Jul 68, [redacted] were briefed by Mr. [redacted] at LAC on the U-2R Air-conditioning/Pressurization System's recent modifications. At the conclusion of this briefing, my notes reflect that [redacted] offered the following comments about the U-2R LOX System:

a. [redacted] (ARO) recommendation of 100 feet of heat exchanger for U-2R is actually bench test requirement and not required in aircraft. Only 25 feet needed in aircraft. The 8 feet being added to bring each system to 27 feet is actually excessive.

b. [redacted] feels ambient oxygen purge adequate for hot, dry climate, but not sure about humid climates. Hot nitrogen purge being investigated.

c. Oxygen vent ports being changed so that oil and grease from aircraft cannot come in contact.

d. [redacted] does not feel that LOX problems due to inadequate heat exchanger, but not sure what was the cause.

On 25 Jul 68, [redacted] notified the undersigned that the F-104s on Main Base (LOX converters same as U-2R, according to [redacted] at ARO) were being purged for two hours with hot nitrogen. [redacted] had previously requested this information and was notified of our findings on 26 Jul 68.

On 26 Jul 68 in a staff meeting, [redacted] gave a rundown on problems and trends in the U-2R. He noted that there had been six LOX writeups, but no problems since the heat exchangers were lengthened.

At a U-2R meeting at [redacted] on 29 Jul 68, my notes show that [redacted] stated that in his opinion the LOX System

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was "marginal in control and operation" but that the increased tubing length seems to have helped.

14. LAC MEETING, 6 AUG 68:

This meeting was primarily concerned with U-2R air-conditioning and pressure suit cooling; however, there was also discussion of the LOX System. My notes reflect that Mr. [ ] gave a resume of problems to date and LAC corrective actions. He summarized by saying that LAC had been unable to demonstrate any component failure to explain the source of the problem, and as a result they were not sure of the reason for the problems. There was some discussion of the operating temperatures of the U-2R LOX System, and [ ] stated that all LAC tests were run at -10°F. [ ] stated that the operating temperatures at altitude were much colder and requested attention be directed to further study the system at colder temperatures.

Following this meeting, the undersigned requested of Mr. [ ] (ARO) that his company attempt to construct an operating full scale model of the U-2R LOX System and expose it to operating temperatures to see if liquid oxygen could get to the pilot if he opened his helmet visor and left the oxygen supply lines on. [ ] promised to look into this.

15. [ ] CHANGE IN LOX SERVICING PROCEDURES:

On 4 Sep 68, [ ] from ARO reported to [ ] to conduct a two-week training program for our Personal Equipment Technicians on S-1010 pressure suit hardware and U-2R LOX System components.

[ ] seemed extremely knowledgeable and interested in LOX Systems, and concurrence was obtained from both [ ] and [ ] DM for him to do some "troubleshooting" into our LOX problems if his training schedule permitted.

On 12 Sep 68, [ ] came to my office with the results of his investigations. He felt very strongly, and had impressive documentation to substantiate his opinion, that our problems of high oxygen pressures and excessive venting overboard of LOX quantity were being caused by our servicing procedures of filling the converters several days in advance and leaving them in the "buildup" mode after servicing. He stated this could cause the condition of "saturation" of the LOX in the converters. This discussion between [ ] and the undersigned occurred at 1700 hours on 12 Sep 68 with [ ] present. Because [ ] was returning to Buffalo that evening, I attempted to contact [ ] to have [ ] brief them, but both had gone for the evening.

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25X1 The following morning (Friday, 13 Sep 68) at 1000 hours,  
25X1 [redacted] ARO Tech Rep) and I  
25X1 briefed [redacted] and Mr.  
[redacted] findings and recommendations.  
They agreed that our high pressure and excessive LOX quantity  
loss problems were possibly due to LOX "saturation". We all  
further agreed to change our LOX servicing procedures to con-  
25X1 form with [redacted] recommendations to me the previous  
evening.

These new servicing procedures agreed upon were as follows:

a. The LOX converters on the U-2R would be filled upon  
landing, and a Life Support technician would then place the  
system in the "vent" mode by installing the vent tool OT 3340  
manufactured and recommended by ARO.

b. At approximately 1-2 hours prior to the next flight,  
a Life Support technician would remove the vent tools and  
place the systems in the "buildup" mode.

c. Maintenance, with the assistance of Life Support,  
would monitor the LOX quantity.

d. Maintenance would refill the LOX converters as  
required.

It was agreed that no satisfactory answer had developed to  
answer our low pressure LOX problems, and close attention  
should still be directed to a possible cause. It was further  
25X1 agreed that [redacted] might be asked to return to [redacted] 25X1  
25X1 at a later date to work with maintenance and Life Support if  
further problems developed.

[redacted] had stated prior to his departure that he was  
going to furnish LAC with a complete rundown of his findings  
and recommendations as soon as he could present them to his  
superiors at ARO. I asked that we be given info copies for  
our files when they were forwarded to LAC.

25X1 At 1700 on 13 Sep 68, we were informed by maintenance that  
the LOX quantity loss from the aircraft placed in the "vent"  
mode that morning was excessive. This problem was discussed  
by telephone with [redacted] (ARO), and he felt this was be-  
cause the LOX in the converters was already "saturated" when  
the vent tools were installed (converters had been filled over  
24 hours before and left in buildup). He recommended that this  
LOX be drained and the converters be filled with fresh LOX and  
placed in vent. These recommendations were relayed to mainte-  
nance and accomplished by them.

There was further discussion between Life Support and Lt Col

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[ ] on Saturday, 14 Sep 68. It was decided that the LOX quantity in the converters would be checked at least every 24 hours by maintenance, and when the quantity approached five liters the converter would be refilled.

At 0800 on Sunday, 15 Sep 68, the undersigned was called at home by [ ] to inform me that A/C 058 and 053 had both been serviced and placed in vent early in the morning of 14 Sep and that so far, their quantity loss was exactly within ARO specifications.

[ ] spent most of the weekend of 13-16 Sep 68 at North Base assisting maintenance and closely monitoring the LOX Systems. He informed me around 0500 hours on 16 Sep 68 that the LOX Systems in 058 and 053 all checked out "perfectly". A/C 058 departed for Scope Cross at 0630 on 16 Sep 68, and had an uneventful flight to destination.

#### 16. [ ] PROBLEMS:

At 0730 on 17 Sep 68, my notes in the Diary reflect that [ ] informed me that 058 at [ ] had aborted its first flight because the #1 LOX System failed to build up pressure after the P.E. Tech removed the vent tool.

Much discussion as to possible cause of this malfunction ensued. At 0930 hours on 17 Sep 68, [ ] (ARO) called to say that it was possible to damage the bellows in the LOX fill-vent valve if their vent tool was tightened down too hard. (Later investigation by ARO and Life Support determined that this could not occur due to the design of this particular tool and that [ ] information was erroneous.)

At 1500 hours on 17 Sep 68, [ ] (LAC) to my office and requested that [ ] be briefed on the "saturation" concept and servicing procedures recommended by ARO and adopted by [ ] was given the same briefing given [ ] DM and his staff on 13 Sep 68. At the conclusion of this briefing, my notes reflect that [ ] stated that [ ] at one time had tried placing an aircraft in the "vent" mode in an attempt to solve some of their LOX problems, but this was abandoned when on one occasion a "vented" aircraft had experienced excessive LOX quantity loss in the hangar. [ ] stated that perhaps improper usage of the venting tool in not completely sealing off the buildup port may have caused this problem, and that perhaps their trial at venting had not been given adequate time to accumulate significant data.

On 18 Sep 68, prior to [ ] departure for [ ] [ ] requested the assistance of [ ] ARO Tech Rep because on preflight, A/C 051 (LOX Systems in

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buildup) was venting LOX out the vent port and had high oxygen pressure on the system. Because "saturation" was the probable cause, the LOX in this system was dumped and the converter refilled. The pressure relief valve apparently had frozen open during the LOX venting overboard, and required that compressed air be blown over it to remove the frosting and allow it to reseal.

At 0800 on 18 Sep 68, [ ] was notified by [ ] Ops that [ ] had aborted again this A.M. because of "Oxygen System problems".

At 1600 on 18 Sep 68, [ ] called me to inform me that "Headquarters has been informed by LAC that all the problems at [ ] due to new LOX servicing procedures adopted at [ ]. I informed [ ] of this conversation.

[ ] 0012 (In 28824 - 17 Sep 68 - Atch 10),  
[ ] 0018 (In 28872 - 18 Sep 68 - Atch 11), and  
[ ] 0032 (In 28980 - 21 Sep 68 - Atch 12)  
succinctly describe the problems encountered at [ ] and corrective actions taken locally.

On 19 Sep 68, [ ] from LAC and [ ] from ARO arrived at [ ] to assist in their LOX problems. [ ] (LAC), dated 24 Sep 68, (Atch 13) outlines his feelings about the problem and his recommendations.

The Life Support Diary on 20 Sep 68 reflects notes of the undersigned after a discussion with [ ] at 0800 hours. [ ] stated that he had talked to [ ] and that the "experts" have concluded that the LOX problems encountered initially at [ ] were caused by retrograde flow of moisture up the vent line by "capillary action" while the vent tool was installed. [ ] apparently does not agree - he feels that if moisture got in the system, it occurred during filling. My notes further reflect that Mr. [ ] apparently told [ ] that "they" felt that venting was a good procedure, however, not to ambient pressure, and that "they" felt that perhaps a new venting tool need be designed that would vent at a little positive pressure (i.e., 10 psi).

On 24 Sep 68, a meeting was called at [ ] to discuss [ ], Lt Col [ ] attended. [ ] stated that the reason we had adopted the new servicing procedures on 13 Sep 68 without getting official permission from LAC was because of the time it generally takes to get official permission from LAC and the fact that we were

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attempting to solve a recurring problem with [ ] and [ ] We were informed by yourself that in your opinion, the LOX problems at [ ] came about because moisture was introduced into the systems. My notes further reflect that you informed us that [ ] (LAC) had proof from another program that moisture or other contaminants could travel "upstream" by retrograde flow with the system in the vent mode, and that on the basis of this proof and the recommendations of LAC to Hqs., we should go back to the "buildup" mode until further study could be directed to the problem. I feel it is worthy of note that from 13 Sep 68 until 24 Sep 68, all the U-2R aircraft at [ ] were left in the "vent" mode, and the only LOX problems that occurred were of the low pressure variety.

We were further informed in the above meeting that both LAC and ARO planned to send LOX experts to [ ] to further study our problems and come up with firm set of guidelines to solve our problems.

17. [ ] LOX MEETING, 30 SEP 68:

On 26 Sep 68, the undersigned was called by [ ] to inquire about a LOX meeting to be convened by LAC on 30 Sep 68. I had no knowledge of such a meeting. At 0900 that same day, [ ] called back to state that Mr. [ ] (LAC) had confirmed the 30 Sep 68 meeting at [ ], and that in addition to LAC, there was to be [ ], ARO, and Hqs representation.

On 27 Sep 68, you informed [ ] and myself that you would be unable to attend the above mentioned meeting and of your thoughts with reference to the [ ] approach to this meeting, which were:

a. Investigate adoption of hot purge (may require LAC mockup of entire U-2R LOX System).

b. If hot purge acceptable, all U-2Rs hot purged by Combat Shack prior to delivery to [ ].

c. All components of LOX System must be thoroughly investigated to see if they meet current specifications, and all specifications examined to see if they are rigid enough for our peculiar requirements.

d. Wants consideration given to changing S-1010 suit regulators so they will selectively feed from high pressure side of dual LOX Systems.

e. If [ ] or Self feel [ ] (WPAFB, Ohio) can make contribution, wants him cleared.

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f. Wants firm set of operating procedures to come out of these investigations.

On 30 Sep 68, this LOX meeting was held in the DM area at [redacted]. The meeting was chaired by [redacted]. Mr. [redacted] meeting notes to [redacted], dated 1 Oct 68 (Atch 14) summarize this meeting fairly well.

Some additional items that were discussed and reflected in my notes are:

a. [redacted] uses 30 psi for filling converters. [redacted] using 40-45 psi - what is recommendation now? [redacted] using 30 psi.

b. [redacted] (ARO) if ARO felt that problems of high pressure due to natural phenomena (i.e., saturation), rather than component failure. [redacted] answered, "Yes, however vent valve can accumulate moisture and freeze open if 120 psi pressures encountered".

c. [redacted] asked by the undersigned for his evidence that contaminants could flow "upstream" in vented system. Mr. [redacted] stated that his evidence was as result of some hydraulic system studies done on another program, rather than on LOX System. He stated evidence "word of mouth only - nothing on paper - shakey at best".

d. [redacted] asked [redacted] why the drain valve froze open on one instance at [redacted] and whether or not this valve cryogenic. [redacted] stated valve cryogenic, however not designed to partially drain system, only to completely drain.

e. [redacted] why S-1010 regulator feeds off low pressure system. [redacted] explained valve in regulator is pressure closing valve, therefore is easier for it to operate against lower pressure.

f. [redacted] asked about causes of low to zero oxygen pressures we have encountered from earliest days of program. [redacted] (ARO) stated might be problem with check valve in system.

18. [redacted] LOX SERVICING MEETING, 2 OCT 68:

The next meeting at [redacted], previously mentioned in the last paragraph of Atch 14 was held on 2 Oct 68. Participants were [redacted] from LAC; Lt Col [redacted]

[redacted] from Hqs Life Support; and [redacted] from ARO. At this meeting, [redacted] notes show that it was

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25X1 agreed to run a comparative study of "vent" vs "buildup"  
 25X1 in the U-2R (A/C 051 and 052 would have #1 LOX System left  
 in "vent" after servicing, and #2 System placed in buildup--  
 A/C 057 and 058 would stay in buildup at all times). Mr.  
 25X1 [ ] stated that [ ] studies on high pressures  
 would tend to support their opinion that high pressures  
 "no problem".

19. FURTHER U-2R LOX PROBLEMS:

25X1 On 7 Oct 68, [ ] noted in the Diary that "Article  
 052 had low warning light on No. 2 Oxygen System for several  
 seconds. No recurrence. No corrective action by the pilot".

25X1 On 9 Oct 68, [ ] noted that: "052--three incidents  
 of low pressure in No. 2 LOX System, followed by zero pressure  
 while descending through 21,000 ft. System checked out O.K.  
 on the ground".

25X1 On 10 Oct 68, [ ] (ARO Tech Rep)  
 25X1 felt that the problem in 052 was a sticking check valve. After  
 discussion with [ ], it was decided to replace the  
 check valve and hot purge the system.

On 11 Oct 68, 052 had three low pressure warning lights on #2  
 system while at altitude (new check valve installed and system  
 hot purged night before). Apparently was decided to change  
 the converter this time.

25X1 On 15 Oct 68, [ ] notes show that 057 aborted pre-  
 flight because of apparent "saturation" of LOX in No. 2 System  
 (using "buildup" mode). [ ]  
 that he felt the problem possibly due to faulty pressure re-  
 lief valve rather than "saturation".

20. [ ] LOX MEETING NO. 3, 29 OCT 68:

25X1 On 25 Oct 68, [ ] (Life Support) attended  
 25X1 a [ ] staff meeting where it was announced there was to  
 be a "LOX problem meeting here this Tuesday at 1000 hours.  
 25X1 [ ] know of this meeting. Hope to have  
 this as final LOX problem meeting by LAC, Tech Reps, etc.,  
 LOX manual update finalization".

25X1 On 29 Oct 68, this meeting was held at [ ] 25X1  
 chaired this meeting in the absence of [ ] Mr. 25X1  
 [ ] on this meeting, dated  
 31 Oct 68, is attached (Atch 15). The undersigned attended  
 25X1 this meeting instead of [ ], and my notes contain 25X1  
 some items of interest not included in [ ] notes: 25X1

a. Discussion of "vent" vs "buildup" occurred. [ ]

S E C R E T

## S E C R E T

(ARO) stated leaving in "vent" will prevent high pressures. [ ] stated that LAC would not go along with "vent". [ ] stated that on A/C 052 there were no problems with system #1 (vent) and several problems with system #2 (buildup). [ ] why LAC rejected the "vent" mode. [ ] replied that this was "uncontrolled condition and danger from contamination". [ ] then again stated that he had no proof that retrograde flow of contaminants can occur in "vent" mode, but that he personally felt this could occur.

b. [ ] to explain our low pressure problems. [ ] replied that "contamination, probably in valves, and probably introduced during servicing".

c. [ ] presented some ARO newly developed check valves with incorporated 20-30 micron filter which they proposed be tested by [ ] or LAC. [ ] stated he would obtain Hqs approval for these tests.

#### 21. LAC BRIEFING FOR [ ] PILOTS:

On 6 Nov 68, [ ] from LAC held a meeting for [ ] pilots on LOX problems. [ ] and [ ] notes show that [ ] stated that our high pressure problems were related to sticking check valves caused by foreign matter introduced probably during servicing. He further stated that contamination probably also causing low pressure problems, but "still some question about this".

At the conclusion of this meeting, [ ] asked Mr. [ ] why LAC had gone back to servicing the aircraft at 35-45 psi when ARO and USAF say 30 psi. [ ] stated that LAC had decided to "forget that" and use 35-45 psi.

22. [ ] continued to have LOX problems. On 21 Nov 68, [ ] noted in the Diary that "055 had low pressure both LOX Systems". Of interest is the fact that Life Support records show that this aircraft had not been hot purged.

[ ] (Out 55385 - 22 Nov 68 - Atch 16) requested further guidance from LAC, stating that instances of both high and low pressures had occurred within the past week. [ ] (In 30730 - 27 Nov 68 - Atch 17) answered this message, and in paragraph 2 recommended that we use the venting tool to reduce pressure and eliminate venting (this is the same venting tool that was incriminated during [ ] LAC further stated in this message (para 3c) that normal oxygen usage rate inflight is "one half liter per hour for both systems".

S E C R E T

## S E C R E T

25X1 On 6 Dec 68, [ ] noted that A/C 054 had high pressure problems with No. 2 LOX System and vented four liters of LOX in one hour in flight. Flight aborted.

23. MEETING, COMMANDER'S OFFICE, 9 DEC 68:

25X1 On 9 Dec 68, [ ] represented the Life Support  
25X1 Directorate at a meeting in [ ] office to discuss 25X1  
25X1 LOX problems. Present, in addition to [ ] and yourself, 25X1  
were [ ] and Mr. [ ] pilots  
[ ] notes reflect  
[ ] to set up another LOX  
25X1 meeting because the [ ] pilots were greatly concerned 25X1  
about the reliability of the U-2R LOX System. [ ] stated  
that ARO had suggested a check valve with a filter and Col  
[ ] rejected this, stating that: "If present check valve  
is problem, get a new one or different type or something".  
25X1 LAC apparently stated at this meeting that they were not  
getting proper advice from ARO and were not happy with the  
situation.

25X1 [ ] (In 31068 - 12 Dec 68 - Atch 18) sug-  
gested another meeting at [ ] during mid-December 68.

24. MORE [ ] LOX PROBLEMS:

25X1 On 12 Dec 68, [ ] from ARO visited 25X1  
[ ] and discussed recent LOX problems with [ ] 25X1  
25X1 and other [ ] went  
from [ ] to LAC to further explore problems.

25X1 On 13 Dec 68, [ ] notes from a staff meeting reflect  
25X1 that Mr. Kelly Johnson now personally involved in the LOX  
problem and felt that the main problem was the check valves.

[ ] Message 1780 (In 31272 - 19 Dec 68 - Atch 19) amplified  
LAC's impression that the check valve was at fault and stated  
that a LAC replacement valve was to be installed ASAP.

On 20 Dec 68, notes of the undersigned in the Diary show that  
A/C 058 had an air abort due to high pressure and excessive  
quantity loss in #1 LOX System and then zero pressure in #2  
System. On this same day, A/C 055 experienced venting of LOX  
from System #1 prior to takeoff. [ ] (ARO Tech Rep) 25X1  
vented off the head pressure and flight launched without  
further incident.

25. NEW LAC CHECK VALVES:

25X1 On 23 Dec 68, [ ] Commander requested that [ ] 25X1  
personnel be briefed on latest LAC changes to LOX System.

S E C R E T



S E C R E T

[ ] 8150 (Out 55811 - 23 Dec 68 - Atch 20).

Between 28 Dec 68 and 13 Jan 69, the LAC check valves were installed in [ ] aircraft. Almost immediately there was a rash of LOX problems. Almost without exception of the low pressure to zero pressure type.

On 3 Jan 69, a meeting was held by [ ] Deputy Commander) with LAC personnel. LAC representatives were [ ]. ARO representative was [ ] representatives were [ ]

[ ]. The main topic of discussion was low to zero pressure problems that had been occurring during the past week despite converter changes, multiple purgings, etc. At this 3 Jan 68 meeting, it was decided to instrument the converter drain valves in 055 to attempt to prove if the problem was indeed the check valves. This was to be done by Combat Shack and flown by a LAC pilot.

26. On 6 Jan 69, the undersigned departed TDY overseas where he remained until 21 Jan 69. During this period, the Life Support file is somewhat incomplete with reference to significant LOX events.

[ ] noted that on 7 Jan 69, A/C 055 had #2 LOX System go to zero pressure inflight. A/C 057 had #1 LOX System go to zero inflight, and A/C 058 had several low pressure warnings on #1 LOX System prior to takeoff and inflight.

On 8 Jan 69, during a [ ] staff meeting, [ ] notes: [ ] gave a short briefing on LOX problems. LAC thinks that check valve is source of problem. They have modified a converter by removing the check valve and putting an additional line to the pressure buildup side. This converter is being installed in A/C 055 and will be flown tomorrow by Hangar 3 (LAC). Further converters are also being modified, but until a definite fix is established, all our aircraft are limited to a ceiling of 45,000 feet."

On 9 Jan 69, [ ] noted in the Diary that 055 had a ground abort due to #2 LOX System venting overboard.

Apparently between 10 and 13 Jan 69, the decision was made to remove the LAC check valves and go back to the older type.

26. SWAP SHOP X:

[ ] (Out 56107 - 10 Jan 69 - Atch 21) recommended that in addition to replacing the LAC check valves, that [ ] aircraft be placed in the "vent" mode after servicing.

S E C R E T

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25X1 [ ] departed with A/C 057 on 14 Jan 69. Enroute, this aircraft experienced excessive venting of LOX overboard, apparently a component failure. The #2 converter was replaced at the first enroute stop, and the remainder of the exercise proceeded free of LOX problems. The "vent" mode was used throughout the exercise.

27. FURTHER LOX STUDIES:

25X1

25X1 [ ] Message 9659 (In 32061 - 22 Jan 69 - Atch 22) laid down new guidelines for [ ] Message 8673 (Out 56333 - 23 Jan 69 - Atch 23) clarified the procedures actually in use at [ ] and by [ ]

25X1

25X1

[ ] Message 9717 (In 32120 - 23 Jan 69 - Atch 24) further amplified on their desire with reference to [ ] LOX servicing procedures.

25X1

28. LOX MEETING, LAC, 28 JAN 69:

25X1 [ ] Message 9682 (In 32079 - 22 Jan 69 - Atch 25) scheduled another LOX meeting at LAC to review current information and proposed solutions.

25X1

[ ] Message 9706 (In 32111 - 23 Jan 69 - Atch 26) outlined an agenda for the 28 Jan 69 meeting at LAC.

25X1

On 28 Jan 69, above referenced meeting was held at LAC. LAC was represented by [ ]

25X1

25X1

[ ] Hqs was represented by [ ]

25X1

[ ] ARO was represented by [ ]

25X1

[ ] was represented by [ ] The undersigned's notes of this meeting reflect some interesting points:

25X1

a. [ ] gave briefing on differences between "old" ARO converter (PM 24,500-1) and "new" LAC converter (RQ 1020), currently installed in A/C 055. Atch 26 is a schematic of both systems.

25X1

b. There appeared to be general agreement, after presentation of [ ] figures, that high oxygen pressures are not really a problem unless excess quantity loss occurs.

25X1

c. [ ] stated that going to "buildup" procedures after the [ ] problems instead of staying with "vent" procedures may have contributed to subsequent rash of LOX problems at [ ]

25X1

25X1

d. [ ] again questioned why we are having problems when the system we started out with works for other aircraft and programs.

25X1

S E C R E T

## S E C R E T

25X1

e. [ ] challenged the LAC position that the check valve in the PM 24,500-1 converter assembly was the problem. He stated that he felt that LAC had insufficient data to support their conclusions and that LAC was basing their conclusions on assumptions rather than fact. [ ] amplified his contention that there was no evidence to support the conclusion that components were the cause of most of the U-2R LOX problems, and questioned the reason for going to a redesigned system before causes were known. [ ] admitted that ARO had been unable to pinpoint the problem.

25X1

25X1

25X1

f. When asked by [ ] why the S-1010 regulator now appeared to selectively feed off the high pressure side of the LAC redesigned LOX System, [ ] apparently modified earlier ARO statements by stating that the regulator normally would feed off the low pressure side, but would also feed off the high pressure side and should not be an area of concern.

25X1

25X1

g. [ ] stated that A/C 058 would go on [ ] with old converters and using "vent" procedures until all answers are known about "new" LOX System.

25X1

h. At the conclusion of the meeting, [ ] stated that if a "new" converter assembly was to be adopted for the U-2R, he would like to suggest the ARO 21170-11 assembly (Atch 28) in use for several years by other government agencies, which takes the pilot supply line from the top of the converter (gaseous) assembly, rather than from the bottom of the converter (liquid) in the LAC RQ 1020.

25X1

i. No decision reached on whether to use "vent" or "buildup" with new LAC converter assembly.

j. LAC stated that oxygen consumption greater than 1.0 liter per hour from both systems was abnormal and indicative of system malfunction.

On 30 Jan 69, the undersigned was notified by [ ] that Hqs would probably recommend the "buildup" mode for the new LOX Systems. [ ] 9971 (In 32391 - 1 Feb 69 - Atch 29) confirmed this information.

25X1

25X1

## 29. SWAP SHOP XI:

25X1

This exercise departed on 5 Feb 69, using A/C 058 with two "old" type converters and using "vent" procedures. [ ] Message 9944 (In 32365 - 31 Jan 69 - Atch 30) established these guidelines.

25X1

On the first leg of [ ], the #2 LOX System went to 130 psi and vented overboard. One of the "new" type converters was installed at the first enroute stop, and the remainder of

## S E C R E T

the exercise was completed with no further LOX problems.  
(System #1 in "vent" and modified System #2 in "buildup").

25X1 30. LATEST [ ] LOX PROBLEMS:

25X1 On 11 Feb 69, [ ] flying A/C 055 with "new" converters installed, had high oxygen consumption for the 8 hour 10 minute flight. Both systems showed 8.5 liters prior to takeoff, and on landing #1 system had 2 1/2 liters and #2 system showed 4 liters. [ ] staff meeting on 13 Feb 69, raised the point that LOX duration may now be a limiting factor in U-2R flight duration. 25X1

On 25 Feb 69, A/C 054 had an air abort due to excessive LOX utilization in #1 system inflight. (This was "old" style converter.)

25X1 31. LATEST [ ] LOX MEETING:

25X1 On 3 Mar 69, LAC sent representatives to [ ] to brief personnel on the latest LAC changes to the U-2R LOX System as a result of the 28 Jan 69 LAC meeting. 25X1

[ ] Message 9397 (Out 57058 - 4 Mar 69 - Atch 31) graphically describes the result of this meeting. [ ] notes also amplify on paragraph 4 of the above message. He did not feel this meeting helped at all in increasing pilot confidence in the "new" LOX System.

25X1 32. Notes of the undersigned from a [ ] staff meeting on 14 Mar 69 show that [ ] stated that LAC was proposing to test a "new" LOX converter that would take the pilot oxygen supply off the gaseous part of the converter (similar to ARO 21170-11). [ ] further stated that Hqs had apparently stated that they (Hqs) were also doing some research on LOX Systems independent of LAC. 25X1

33. This concludes the review of information available to me to this date on U-2R LOX problems.

34. CONCLUSIONS:

If any conclusions can be arrived at with reference to this review of information, they would probably have to include the following:

a. Initially, in the earliest planning stages of the U-2R, not enough attention was devoted to consideration of possible differences between the SR-71 and U-2R. Rather than design and fully bench test a LOX System solely for the U-2R, the SR-71 System was carried over and installed.

S E C R E T

b. Once a LOX System was adopted for the U-2R, insufficient attention was devoted, by all parties concerned, to servicing procedures for this system.

c. With each successive LOX problem, there appears to be no consistency to the approach of interested parties as to possible etiologies and solutions. Erroneous information and inadequate guidance were often the rule rather than the exception.

d. Throughout this entire period of time, there appears to have been an increasing level of communication breakdown between the primary contractor for the U-2R LOX Systems (LAC), and their sub-contractor (ARO), which undoubtedly aggravated the problem.

e. As a result of the difficulties encountered with the U-2R LOX System, and the many less than successful approaches to solutions, the level of pilot confidence in this system was drastically reduced.

35. This lengthy memorandum, prepared at your request, has been presented objectively to the best of my ability. My only interest in this controversy since the first day of my assignment to this organization has been the welfare of the pilots who fly the U-2R, and their confidence in their Life Support Systems.

[Redacted Signature]

Director, Life Support

MC, FS

31 Atch  
Noted

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Next 6 Page(s) In Document Denied

ate	10 JUL 1968
OIC	<i>[Signature]</i>
Asst	<i>[Signature]</i>
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P.E.	<i>[Signature]</i>
Surv	<i>[Signature]</i>

**S E C R E T**

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IN 27164

TOR: 051734Z JUL 68 DES

**S E C R E T** 051725Z JUL 68 CITE  4003

IMMEDIATE

IDEALIST DM-1  R&D

REF:  5563 (OUT 53227)

FROM

I SHARE THE CONCERN EXPRESSED BY  IN REF, LIKEWISE  
CONSIDER THE PROBLEM A SAFETY OF FLIGHT ITEM WHICH COULD HAVE AN  
ADVERSE AFFECT ON THE CAPABILTY OF THE R MODELS TO MEET ITS DESIGN  
SPECIFICATIONS. REQUEST YOUR EXPEDITED ACTION TO DETERMINE CAUSE  
AND DEVELOPMENT OF THE NECESSARY FIX TO ELIMINATE THIS CONDITION.

END OF MSG

LOX SYS PRESSURE DROP

Atch 4  
NOY

IN 27164

**S E C R E T**

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**SECRET**

LIFE SUPPORT

Date **10 JUL 1968**

OIC

Asst

Med

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IN 27173 **SECRET**

TOR: 05/2318Z JUL '68 DES

FOR MONITORING OF THE MOISTURE MONITOR : 052, 053, 056, WE HAVE BEEN  
 ADVISED THAT THE MONITOR IS NOT WORKING.

**SECRET** 052132Z JUL '68 CITE [REDACTED]

PRIORITY [REDACTED]

NO NIGHT ACTION

IDEALIST [REDACTED]

REF: (A) [REDACTED] 5563 DTD 5 JULY 68 (XNOUT 53227)

(B) [REDACTED] 4003 DTD 5 JULY 68 (IN 27164)

(C) TELECON [REDACTED] DTD 5 JULY 68

(D) TELECON [REDACTED] DTD 5 JULY 68

AFTER THOROUGH EVALUATION OF ALL THE FACTS INVOLVED

IN THE RECENT OXYGEN INCIDENTS ON ARTICLES 052, 053, AND 056,

IT IS APPARENT THAT WE HAVE A MOISTURE PROBLEM WITH OUR

OXYGEN. AT THE REQUEST OF [REDACTED] PERFORMED

A MOISTURE CHECK ON THESE ARTICLES AND THEY FAILED TO PASS.

UNTIL FURTHER NOTICE, THE U-2C MOISTURE MONITOR SHALL BE

USED AS A PRE-FLIGHT ITEM TO CHECK CONDITION OF OXYGEN.

ALSO, ALL OXYGEN SYSTEMS ON U-2R SHALL BE DRAINED AND LEAK

CHECKED, PURGED AND RE-SERVICED PRIOR TO NEXT FLIGHT. THE

EXISTING PURGE TIMES CALLED FOR IN OUR TECH DATA SHALL BE

DOUBLED. OF COURSE, AFTER THE ABOVE SERVICING, THE MOISTURE

MONITOR SHALL BE USED.

IN 27173

**SECRET**

Atch 6'  
 LOX

PAGE 1 OF 2

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Date	15 JUL 68
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**S E C R E T**

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IN 27332  
TOR 12/1441Z JUL 68 JMP

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**S E C R E T** 112329Z JUL 68 CITE   0332

IDEALIST  

REF: (A)   003, DTD 05 JUL 68 IN 27164  
(B)   5563, DTD 05 JUL 68 OUT 53227

SUBJ: STATUS OXYGEN INVESTIGATION

AS A RESULT OF THE RECENT INCIDENTS ON THREE ARTICLES, WHERE ONE OXYGEN SYSTEM INDICATED 0 PRESSURE DURING FLIGHT, THE FOLLOWING PROGRAM IS BEING ACCOMPLISHED.

THE OXYGEN CONVERTERS HAVE BEEN FUNCTIONALLY CHECKED IN   LABORATORY AND FOUND TO BE SATISFACTORY. ONE CONVERTER WAS TESTED FOR OPERATION IN A COLD ENVIRONMENT TO SEE IF THE HEAT EXCHANGER WAS CAPABLE OF WORKING AND RE-PRESSURIZING THE SYSTEM AT LOW AMBIENT TEMPERATURES. THESE TESTS WERE COMPLETED P.M. OF 10 JULY AND WERE SATISFACTORY. FURTHER, AS A RESULT OF INVESTIGATION, IT WAS DISCOVERED THAT THE PLUMBING TUBE FROM THE COVERTER TO THE COCKPIT WAS NOT AS LONG AS REQUIRED BY MIL SPEC (DURING FLIGHT TEST EVALUATION OF THE LOX SYSTEM EARLY IN THE PROGRAM, TEMPERATURE

*Atch 7'*  
*LOX*

25X1 PAGE 2 [ ] 0332 S E C R E T

MEASUREMENTS WERE MADE TO ASSURE THAT THE TUBE WAS NOT ALLOWING LIQUID INTO THE COCKPIT AREA. THESE MEASUREMENTS SHOWED ONLY A 10 DEG DELTA T BETWEEN AMBIENT COCKPIT TEMPERATURE AND THE O2 LINE.) IN ORDER TO CONFORM TO THE MIL SPEC, [ ] IS IN THE PROCESS OF MOCKING UP ADDITIONAL TUBING (APPROXIMATELY 8' ADDITIONAL). IT IS ANTICIPATED TWO SETS OF TUBES WILL BE AVAILABLE EARLY IN THE WEEK OF THE 15TH.

ANOTHER AREA NOT CONFORMING TO MIL SPEC IS THE REQUIREMENT FOR SYSTEM PURGE. THE EXISTING U-2R TECH DATA IS PATTERNED AFTER THE SR-71, WHICH REQUIRES A TOTAL PURGE TIME OF 22 MINUTES. THE MIL SPEC REQUIRES A MUCH LONGER PERIOD. ALSO, THE MIL SPEC REQUIRES THAT THE PURGE BE ACCOMPLISHED HOT (250 DEG-F). STARTING IMMEDIATELY, ALL SYSTEMS SHALL BE PURGED ONE HOUR AT 50 PSI WITH DRY AMBIENT OXYGEN. [ ] 25X1 WILL INVESTIGATE AND TEST THE HOT PURGE FOR POSSIBLE FUTURE USE.

ALSO, STARTING IMMEDIATELY, THE U-2C MOISTURE MONITOR SHALL BE EMPLOYED. AFTER INSTALLATION OF THE ABOVE PLUMBING TUBES, THE SYSTEMS SHALL BE PURGED AS ABOVE,

RXG IN 27332

S E C R E T

PAGE 2 OF 3

Atch 72

25X1 PAGE 3  0332 S E C R E T

CHARGED AND THEN CHECKED WITH THE MOISTURE MONITOR  
25X1 FOR CONDITION. THE MOISTURE MONITOR SHALL BE USED AT  
EACH 30-DAY PERIOD WHEN THE SYSTEM IS PURGED AND RECHARGED.

CONCURS WITH THE ABOVE PROCEDURE.

25X1 TO DATE  HAS NOT FOUND ANY COMPONENT MALFUNCTION  
WHICH COULD HAVE CAUSED THE INCIDENTS. HOWEVER, THERE  
IS SOME SUSPICION THAT MOISTURE HAD EXISTED, BUT THIS  
CANNOT BE PROVED AT THIS TIME. IT IS FELT WITH THE INCREASED  
PURGE TIME AND THE USE OF THE MOISTURE MONITOR FURTHER  
PROBLEMS SHOULD BE ELIMINATED.

END OF MSG

Atch 7<sup>3</sup>

L.S.

SECRET

LIFE SUPPORT	
Date	22 JUL 1968
O.C.	<u>22</u>
Asst	_____
Med	_____
P.E.	_____
Surv	_____

IN 27455  
TOT 18/1452Z JUL 68 JMP

SECRET 181441Z JUL 68 CITE [ ] 4303

25X1

PRIORITY [ ]

IDEALIST [ ] LIFE SUPPORT

REF [ ] 3949 IN 27131

THE WORKING MEETING AT [ ] ON SUBJ OF AIR CONDITIONING/  
PRESSURE SUIT VENTILATION HAS BEEN CANCELLED FOR 22 JULY AND  
WILL BE RESCHEDULED FOR EARLY AUGUST. ALL ADDRESSEES WILL BE  
NOTIFIED AS SOON AS NEW DATE CAN BE DETERMINED.

END OF MSG

Atch 8

IN 27555

SECRET

**Page Denied**

**S E C R E T**

LIFE SUPPORT	
Date	17 SEP 68
OIC	<i>[Signature]</i>
Asst	
Med	
P.E.	
Surv	

IN 28824

TOR: 17/1835Z SEP 68 WP

**S E C R E T** 171423Z SEP 68 CITE  0012

25X1

IMMEDIATE

IDEALIST  DM-3, PE,

25X1

MISSION GT 68-423 CANCELLED DUE TO OXYGEN PROBLEMS. NUMBER 1 SYSTEM WOULD NOT BUILD UP AFTER SYSTEM WAS PLACED IN BUILD UP POSITION. FOLLOWING NEW PROCEDURES, ARTICLE WAS SERVICED WITH LOX AFTER LANDING LAST NIGHT AND SYSTEM LEFT IN VENT POSITION. SYSTEM LOOKED GOOD AT PRE-FLIGHT THIS MORNING HOWEVER, AFTER SEAT KIT WAS PLACED IN COCKPIT THIS MORNING, BUILD UP POSITION WAS SELECTED BUT NO BUILD UP IN NUMBER 1. WE SUSPECT VALVE FREEZE UP AS CHECKS OF SUIT, O2, ETC ALL OKAY. WILL ADVISE RESULTS AFTER PURGE.

**XXXXXX** END OF MSG

IN 28824

**S E C R E T**

*Atch 10*



**S E C R E T**

IN 28872

TOR 18/1817Z SEP 68 JMP

LS

LIFE SUPPORT	
Date	0 SEP 1968
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**S E C R E T** 181550Z SEP 68 CITE  0018

25X1

IMMEDIATE

IDEALIST, PE, R&D, DM,

SUBJ: PROBLEMS ASSOCIATED WITH ENVIRONMENTAL TEST OPERATION  
AT  WITH ARTICLE 058.

1. FOLLOWING IS RESUME OF EVENTS AFTER CANCELLING FLT OF ARTICLE 058 ON TUESDAY 17 SEP. AFTER SYS NBR 1 OF THE OXYGEN SYSTEM HAD FAILED TO BUILD UP PRESSURE THE PILOT WAS REMOVED FROM THE COCKPIT AND A MOISTURE CHECK WAS ATTEMPTED ON SYS NBR 2. AS THIS CHECK WAS BEING MADE SYS NBR 2 PRESSURE WENT TO ZERO. THE FILLER VALVES WERE TAPPED LIGHTLY WITH A Mallet TO SEE IF THIS MIGHT BE THE PROBLEM BUT NO LUCK.

2. SYS NBR 1 WAS PURGED WITH GASEOUS OXYGEN AND RESERVICED WITH LOX. PRESSURE BUILT UP TO NORMAL OPERATING RANGE AND REMAINED THERE OVERNIGHT.

3. SYS NBR 2 WAS PURGED AND RESERVICED BUT PRESSURE DID NOT BUILD UP. THE FILL VENT VALVE WAS REPLACED AND SYSTEM REPURGED AND SERVICED. PRESSURE BUILT UP AND REMAINED THERE OVERNIGHT. BOTH THE NBR 1 AND NBR 2 SYSTEMS WERE LEFT IN BUILD UP OVERNIGHT. NO HIGH PRESSURE VENTING OCCURED ON EITHER SYSTEM. BOTH SYSTEMS WERE

25X1 PAGE 2   0018 S E C R E T

PERIODICALLY FLOW CHECKED, AND MOISTURE CHECKED SATISFACTORILY.

4. AN ENGINE RUN WAS MADE AND DURING THIS RUN THE FLAPS WERE FOUND TO BE INOPERATIVE. THE FAULT WAS MOISTURE IN THE RIGHTHAND ASSYMMETRY SWITCH. IN FACT IT WAS SATURATED WITH MOISTURE. REMOVED SWITCH AND DRIED WITH NITROGEN. LEFT SWITCH WAS ALSO REMOVED AND DRIED ALTHOUGH IT DID NOT SHOW ANY MOISTURE. THE DRAIN HOLE WAS COVERED WITH TAPE TO PREVENT REOCCURANCE. AFTER RESET OF FLAP RELAY THE FLAPS OPERATED NORMALLY ON NEXT ENGINE RUN.

5. DURING THE FIRST ENGINE RUN FUEL PRESSURE WENT TO 35 PSI ON SHUTDOWN. THE TRANSMITTER WAS REPLACED AND FUEL PRESSURE WAS NORMAL ON THE SECOND RUN AND SHUTDOWN. ON THE THIRD RUN FUEL PRESSURE AGAIN WENT TO 35 PSI ON SHUT DOWN. ELECTRICAL POWER APPLIED TO ARTICLE AND FUEL PRESSURE INDICATED NORMAL. DURING ALL ENGINE OPERATIONS FUEL PRESSURE WAS NORMAL. FUEL PRESSURE GAGE IS SHORT IN FAK.

6. MAINTENANCE WORK WAS COMPLETED AT 0130 HOURS WED MORNING AFTER A 17 HOUR DAY. TO LAUNCH TODAY'S FLIGHT MAINT PERSONNEL REPORTED FOR WORK AT 0730 HOURS.

7. ARTICLE ALL OKAY ON PREFLIGHT EXCEPT FULL PRESSURE. SECONDS AFTER ENGINE START NBR 2 OXYGEN SYSTEM PRESSURE PEGGED AT 130 PSI, EXCESSIVE DUMPING AT VENT ALSO OCCURED. SHUTDOWN (ENGINE) AND

EN 28872

S E C R E T

PAGE 2 OF 3

21.1 112

25X1 PAGE 3 [ ] 3018 S E C R E T

IMMEDIATE PRESSURE CHECKS WERE MADE. TEST SET SHOWED 125 PSI ON NBR 2 OXYGEN SYSTEM. NBR 1 WAS NORMAL 80 PSI. WE BLED NBR 2 DOWN TO 88 PSI, AND IT IMMEDIATELY COMMENCED TO BUILT UP PRESSURE.

8. INVIEW OF THE LIMITED TEST CAPABILITY AND LACK OF ENGINEERING KNOWLEDGE AVAILABLE, AND SEEMING ERRATIC BEHAVIOR OF OXYGEN SYSTEM, [ ] COMMANDER CANCELLED TODAYS FLIGHT ON THE BASIS OF FLIGHT SAFETY.

9. [ ] HAS REACHED THE POSITION OF NOT BEING ABLE TO COME UP WITH CORRECTIVE ACTION ON 58'S OXYGEN SYSTEM BECAUSE OF LACK OF TECHNICAL KNOWLEDGE AND TEST EQUIPMENT. VIEW THESE LIMITATIONS, WE SEE TWO CHOICES.

A. FLY ART HOME AT LOW ALTITUDE, OR PREFERRABLY

25X1 B. REQUEST [ ] DISPATCH TO [ ] APPROPRIATE SIZED AND EQUIPPED LAC TEST FORCE. THIS GROUP SHOULD BE AUGMENTED WITH APPROPRIATE ABAFT REPRESENTATIVES.

10. REQUEST ADVISEMENT SOONEST.

END OF MSG

*Atch 113*

LS

S E C R E T

LINE 1	
DATE	22 SEP 1968
ORG	
Asst	
Med	
P.E.	
Surv	

IN 28980

TOR: 211354Z SEP 68 DES

S E C R E T 201950Z SEP 68 CITE [ ] 0032

25X1

25X1 PRIORITY [ ]

25X1 IDEALIST OPERA DM R&amp;D [ ]

SUBJ: OXYGEN PROBLEMS ART 058

FOLLOWING IS RESUME OF EVENTS AND ACTIONS TAKEN

ON ARTICLE 058 SINCE ARRIVAL OF [ ] DEPLOYMENT:

25X1

16 SEP - PM. LOX SERVICED AND VENTED TO ATMOSPHERE OVERNIGHT.

17 SEP - A.M. - VENT TOOLS REMOVED - 10 MINUTES PRIOR

TO PILOT LOAD NUMBER 1 SYSTEM WOULD NOT BUILD UP ABOVE

30 PSI AND WOULD RETURN TO ZERO ON DEMAND NUMBER 2

SYSTEM OPERATION NORMAL. FLIGHT ABORTED ON ATTEMPT

TO MOISTURE CHECK NUMBER 2 SYSTEM IT WENT TO ZERO PRESS-

URE AND WOULD NOT BUILD UP TO OPERATING PRESSURE -

SAME SYMPTOMS AS NUMBER 1 SYSTEM. DUMPED LOX FROM BOTH

SYSTEMS - PURGED AND SERVICED NUMBER 1 SYSTEM PER

LATEST PURGE PROCEDURE. PRESSURE BUILDUP AND SYSTEM

OPERATION (NUMBER 1 SYS) APPEARED NORMAL. MOISTURE

CHECK AT MINUS 65 DEGREES F. PURGED AND SERVICED

NUMBER 2 SYS PER LATEST PROCEDURE. NO PRESSURE BUILDUP AS

BEFORE. DUMPED LOX FROM NUMBER 2 SYS, REPLACED FILL AND

IN 28980

S E C R E T

44.6 12'

PAGE 1 OF 3

25X1 PAGE 2  0032 S E C R E T

VENT VALVE, PURGED, AND SERVICED. NO BUILDUP UNTIL PRESSURE DIFFERENTIAL VALVE WAS TAPPED. PRESSURE BUILDUP AND SYS OPERATION APPEARED NORMAL, MOISTURE CHECK NUMBER 2 SYS - 68 DEGREES F. NUMBER 1 AND NUMBER 2 SYSTEMS WERE LEFT IN BUILDUP OVERNIGHT. NO EXCESSIVE PRESSURE OR RELIEVING OBSERVED BY OVERNIGHT WATCH.

18 SEP - NUMBER 2 SYS BUILT UP TO 130 PSI AND RELIEVED WITH PILOT HOOKED UP JUST PRIOR TO TAXI. PRESSURE TESTER HOOKED UP TO NUMBER 2, READ 125 PSI. DROPPED PRESSURE BY FLOWING TO 38 PSI. IT THEN BUILT TO 90 PSI. PILOT WAS RECONNECTED TO NUMBER 2 SYS, NUMBER 1 SYS WAS TURNED OFF, AND PRESSURE IN NUMBER 2 BREATHED DOWN TO NORMAL OPERATING RANGE. FLIGHT ABORTED. FLOW CHECKS PERFORMED HOURLY THROUGHOUT AFTERNOON BOTH SYS NORMAL. FIREWELL/LOCKHEED TEAM DUE TOMORROW.

25X1 19 SEP -  (LOCKHEED) AND  25X1  
(FIREWELL) ARRIVED. CHECKED NUMBER 1 AND NUMBER 2 SYS PRESSURE - BOTH HAD BEEN LEFT ON BUILDUP SINCE FLIGHT ABORT 18 SEP A.M. NUMBER 1-110, NUMBER 2 -115, VENT FLOW - 2000 CC/PER MIN. FLOWED BOTH SYSTEMS FROM QD FOR 1 MINUTE. PRESSURE REMAINED ABOVE 100 PSI INDICATING

IN 28980

S E C R E T

Atch 12<sup>2</sup>

25X1 PAGE 3   0032 S E C R E T

LOX NEAR SATURATION. FLOWED BOTH SYS BELOW 100 PSI AND CHECKED VENT FLOW - ZERO, INDICATING GOOD RELIEF VALVE SHUTOFF AND NO FILL AND VENT VALVE LEAKAGE. SERVICED NUMBER 1 AND NUMBER 2 SYS, BOTH PRESSURE NORMAL 75 PSI. INSTALL VENT TOOL IN NUMBER 2 SYS FOR OVERNIGHT CHECK. SYS PRESS ZERO, NUMBER 1 SYS LEFT IN BUILDUP AND PRESSURE MONITORED THROUGHOUT NIGHT - 74-75 PSI.

20 SEP - VENT TOOL REMOVED FROM NUMBER 2 SYSTEM, BUILD UP TO 75 PSI NORMAL - 3 MIN. LOW ALT MASK HOOKED TO NUMBER 1 AND NUMBER 2 FOR BREATHING CHECK. NORMAL OPERATING PRESSURE WAS OBSERVED FOR 3 PLUS HOURS OF BREATHING. SERVICED NUMBER 1 AND NUMBER 2 SYS. BUILDUP TO 75 PSI PRESSURE WAS NORMAL ON BOTH SYSTEMS. ONE HOUR AFTER SERVICE, CREW CHIEF WAS HOOKED TO NUMBER 1 AND NUMBER 2 SYS WITH LOW ALTITUDE MASK AND OXYGEN PRESSURE OBSERVED DURING 20 MINUTE PREFLIGHT ENGINE RUN, OPERATIONAL NORMAL.

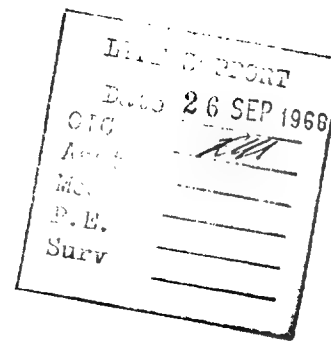
END OF MSG

IN 28980

S E C R E T

*Atch 12<sup>3</sup>*

24 September 1968



TO:

FROM:

SUBJECT: OXYGEN SYSTEM U-2R

The recent problems with subject system at McCoy AFB have created considerable interest in the system, its handling procedures and problems. This memo will attempt to summarize the status of the system problems and recommend corrective action.

Apparent problems associated with high pressure, excessive loss, uneven feeding of systems have been occurring since the early flight days of the U-2R. These have been corrected by replacement of components, thawing valves, bleeding pressure prior to flight, etc. The actual cause of the problem, if one really existed, was never really determined. Feed-back from the test lab or the vendor never reported finding a bad component.

The cause of cases of failure to feed last summer was not actually determined. It was assumed that they were caused by moisture in the system or liquid oxygen getting up into the system shut off valve. At this time the purge procedure was revised to resolve the moisture problem and additional length of line was added to the build up system. This corrective action appeared to eliminate the feed failure problems.

Pressures over the normal operating range of 50 to 100 psi were being experienced daily. In most cases, bleeding the pressure prior to takeoff allowed them to remain within the normal range during the flight. There have been a few cases where, concurrent with high pressure, the quantity depleted rapidly. These were assumed to be caused by faulty converters or LOX freezing a valve open. In some cases, converters were replaced and in others shop air was blown on the components with external ice build up. In no case has a definite cause been established.

Recently, [redacted] of ARO Corporation paid a visit to Detachment G to discuss another subject. While he was there, it was learned that he was quite knowledgeable of LOX systems so he was briefed on their problems by [redacted] and his staff. [redacted] assessed their high pressure problems to be caused by heat saturation of the LOX. He defines heat saturation as LOX that has been in the converter for extended periods with the system in build up. When this occurs, the pressure opens the

SECRET

AHach 13'

-2-

relief valve and higher than normal loss through the external vent is experienced. He used a flowmeter at the vent on the aircraft to demonstrate the difference between fresh LOX and saturated LOX.

25X1

[ ] recommendation to alleviate this condition was to leave the fill valve in vent rather than build up after servicing the aircraft with LOX. Accomplishment of this on the U-2R requires insertion of a special tool in the Fill and Vent valve. Detachment G personnel were sold on the procedure and decided to put it into effect the weekend of 14 Sept 1968.

25X1

Some time back, [ ] of ARO had recommended this same procedure as a solution to the uneven feeding problem. In the uneven feeding cases, the highest pressure system usually would not come on the line until the low pressure system was turned off. Experience had shown that if the pressures were bled down prior to flight, both systems were more likely to feed simultaneously. [ ] procedure was tried on A/C 051 with mixed success. The first time it worked satisfactorily and the next two times excessive LOX was lost overnight, so the procedure was abandoned.

25X1

Meanwhile, we had heard from several sources that all other aircraft using LOX had a manual vent valve. These valves were supposedly left in Vent position until flight time. We have now been advised by [ ] of Wright Patterson Oxygen Lab that this is not being done on other aircraft. There always is a hazard of contaminants entering the system through the open vent. The T.O.'s on the KC 135 and F104 warn against this.

25X1

Concurrent with Detachment G going to the venting procedure, they deployed A/C 058 to McCoy AFB for high humidity environmental tests. The first two flights were aborted due to oxygen system problems prior to takeoff.

Upon its arrival at McCoy AFB, A/C 058 was immediately serviced with LOX. The aircraft was very wet due to condensation. From what information that could be obtained from the ground crew, it is fairly certain that no special precautions were observed in servicing. Both systems were left in vent overnight. The next morning one system failed to build up and the other built up, but it went flat when a demand was placed upon it.

Extensive purging was accomplished on both systems and the aircraft prepared for flight the following day. After purging, one system would not build up until the converter valves were tapped vigorously. The Fill and Vent valve in this system was replaced and additional purging accomplished. The systems were left on build up overnight. The next morning, just prior to taxi, one system went up to 130 psi and vented overboard. The pressure was bled down in the cockpit and then remained down. The flight was not made.

AHack 13<sup>2</sup>



-3-

25X1 [ ] and the writer proceeded to McCoy AFB  
25X1 and met [ ] there. After carefully reviewing their experiences, we  
concluded they had experienced problems associated with moisture contam-  
ination and also a high pressure problem.

Attempts to repeat the contamination problem by leaving in vent  
were unsuccessful. However, everyone was much more aware of moisture  
hazards and probably were more careful during servicing than they had been  
on the initial service at McCoy AFB. As the investigation progressed, any  
logical changes to existing procedures were passed to Project Headquarters  
and Edwards for immediate adoption.

To preclude saturation effects causing high pressure and subsequent  
loss of LOX, it appeared desirable under certain conditions to partially  
drain the system and reservice. On one occasion at McCoy AFB a drain  
valve froze open during draining and would not close. This caused the  
system to drain to empty. The valve is supposedly a cryogenic valve  
and should not do this, but it did. This experience made it undesirable  
to continue the partial draining procedure.

In discussing the purge procedure with the crew at McCoy AFB, it was  
learned that it is not fully being accomplished due to a misinterpretation of the  
instructions. They have been trying to hold the specified pressure at each  
end of the system, thereby not getting the desired flow.

Lockheed has purposely avoided a hot purge due to reported fires  
experienced in the early use of this procedure. We now hear that hot  
purging is being done on many aircraft and there are several small  
approved purging units on the market.

25X1 A review of the SR-71 oxygen system experiences and problems  
with [ ] indicates they are having practically no problems. They  
use the same components we use but the system is assembled differently  
due to having two crew members and three systems. They are not concerned  
with high pressure and uneven feeding. High pressure is ignored unless  
there is an excessive loss of oxygen indicating a valve malfunction. Uneven  
feeding is not a problem because they were taught not to expect the systems  
to go down evenly. They accept the fact that the system not feeding is on  
standby and is available in case of failure or depletion of oxygen in the  
feeding system. The aircraft are and have been for some time operating  
in a very humid climate.

At this time it appears that our oxygen system problems are caused  
by several factors:

1. Inadequate or obsolete procedures available to the using personnel.


Attach 13<sup>3</sup>

-4-

2. Improper use of existing procedures.
3. Poor coordination between LAC, ARO, and the Customer.

Recommendations for resolving the present difficulties are:

1. Qualified LAC, ARO, and AMC engineers spend some time at Detachment G developing firm handling and troubleshooting procedures.
2. Ground and Flight personnel be instructed on above procedures.
3. Investigate and flight test operating with high pressures, as are being accepted on the SR-71.

  
Division Engineer  
Flight Test

25X1

GCT:slh

cc:



25X1

*Attach 13<sup>4</sup>*

To: [REDACTED]

From: [REDACTED]

1 October 1968

Subject: LOX Meeting - Edwards North Base

STATINTL A meeting on LOX System problems was held at North Base, 30 September 1968. Those in attendance were:

- ↓ [REDACTED]
- WRSP IV DM
  - WRSP IV Life Support
  - Project Hq. Life Support
  - ARO Corporation
  - ARO Corporation
  - LAC Flight Test
  - LAC Design
  - LAC Design
  - LAC Maintenance Manuals
  - LAC Maintenance Manuals

The subjects covered and their conclusions are:

High Pressure - It was contended by ARO Representatives that excessive loss can be expected from high pressure on a normal system if the LOX is saturated. Flight Test will attempt to confirm this on Aircraft 051. The best way to prevent saturation is to service close to flight time. However, some time must be allowed for stabilization after servicing. The Detachment will service LOX between eight and one hours prior to flight. Servicing will be accomplished within this period even though the quantities are full from a previous servicing. The reservicing allows fresh LOX entering the converter from the bottom to displace and mix with the saturated LOX. This eliminates the need for partially draining prior to servicing.

Abnormal Operation - It was generally agreed that past history shows the oxygen system components are quite reliable. Air Force experience has been that most all LOX system problems are caused by contaminants. In view of this it was concluded that the first course of action on abnormalities that are obviously not a failed component shall be purging.

Purging - A lengthy discussion was held on purging. ARO recommended hot purging. The basic Air Force Tech Order recommends hot purging. Information from Edwards Main Base indicated there was confusion there regarding use of hot purge. It appears that hot purge would be more effective in removing moisture and should require less time to do it. The present U2R cold purge time is comparable to the Air Force recommended hot purge time. Our purge time is considered marginal and [REDACTED] if hot purge is not adopted. It was concluded we should go [REDACTED] if LAC agrees that the total system can tolerate the temperature. ARO will work with [REDACTED] in STATINTL [REDACTED] with a suitable Hot Purge Unit for test.

Purge Frequency - It was generally agreed that servicing cycles are a better criteria for purge frequency requirements. Twenty five servicings was decided upon for a starting point. The calendar requirement is to be deleted.

Atch. 14'

STATINTL

System Improvements - [ ] is to investigate the feasibility of two small system changes that will reduce the chance of moisture collecting in the bellows area of the relief valves and assist in trouble shooting the system. The lines from the relief valves should be routed directly down rather than loop up over the duct. They can be teed together and should have their own overboard fitting rather than be teed into the vent fitting.

STATINTL

Preflight - It was recommended that a flowmeter check of the vent be included in the preflight. ARO has limits on the flow and feels potential problems with vent and relief valves may be detected. [ ] is to look into available meters for this purpose. STATINTL  
STATINTL

[ ] is to remain at North Base this week and monitor all flights and LOX servicing. Ed appears to have a good grasp of the situation so [ ] has returned to the plant.

We plan to have another meeting Thursday, 3 October 1968 at 0900 to review the weeks operation. At this time interim procedures should be finalized and a message sent to SAC. Manual revisions should be held in abeyance until 1 November 1968. STATINTL



GCF:tec

STATINTL

c: All Attendees



File

Atch 142

Received  
5 Nov 68  
KHA

To: [REDACTED] 31 October 1968

From: [REDACTED]

Subject: LOX Meeting - Edwards North Base

STATINTL

A third meeting was held on 29 October 1968 to summarize all past LOX experience, operating characteristics and finalize operating procedures. Those in attendance were:

- WRSP IV DM
- WRSP IV Life Support
- Project Hq Life Support
- WRSP IV Maintenance
- ARO Corporation
- LAC Design
- LAC Maintenance Manuals
- LAC Maintenance Manuals
- LAC Flight Test
- LAC Flight test

HIGH PRESSURE - High pressure/saturated LOX was investigated on 051 during the period 1 October thru 23 October 1968. A total of nine flights were made. Servicing occurred approximately every 3 days. Only one case of LOX venting overboard in flight was noted and this could not be attributed to a so called saturated condition in that the system was serviced just 6 hours before the flight. The system also operated satisfactorily for 5 subsequent flights with no system changes or purging. It is also interesting to note that in all cases either with system #1 or #2, the flights were started with high pressures between 100 and 110 psi and these pressures gradually reduced to 70-80 psi level as the flight progressed. On the basis of the above it appears that high pressures are acceptable providing that excessive venting does not take place.

It is recommended that the -2-1 servicing instructions state that primary servicing will be during the 24 hour to 1 hour period prior to flight to preclude high pressures; however, under extenuating circumstances where no LOX is available the system may be continued in service with high pressures, but not venting overboard.

It is recommended that the flight manual contain information to observe the LOX quantities and usage rates with attendant high pressures. It should also be noted that it is not recommended that neither of the oxygen systems be shutoff in flight.

SERVICING - Agreement was obtained that normal servicing will be done prior to each flight between the period 24 to 1 hour prior to flight. This has provided excellent results and is compatible with flight scheduling and maintenance procedures. Detachment "G" has averaged between 14-16 hours prior to flight for servicing.

It is our strong belief that most difficulties have been caused by some form of contamination. The following items of servicing and maintenance should be closely controlled and noted in the -2-1.

- LOX Quality
- Receptacle cleanliness - Dirt and dust
- Receptacle Moisture
- Worn Parts
- Servicing under inclement weather conditions

Atch 15'

PAGE: 2

LOX CART PROCEDURES - It was agreed to service the LOX systems at 35-45 psi LOX cart delivery pressure.

PURGING - Hot purge procedures have been instituted and are working satisfactorily to date. This is now standard procedure.

VENTING - It was agreed to leave systems in buildup to preclude the possibility of contamination. This advantage outweighs the advantage gained by leaving the system in vent and avoiding saturated LOX.

SYSTEM CHANGES - S/D 351-97 information and parts will be available in the very near future. This bulletin provides separate vents for filling and relief valve, venting for purposes of system trouble shooting.

INFORMATION TO THE FIELD - Filling, servicing and maintenance procedures based on the above info will be released to the field as soon as possible.

One area yet to be completed in this regard is the trouble shooting section. This work will be started as soon as possible.

An agenda for oxygen updating classes for both maintenance personnel and drivers was distributed and accepted. These classes will be conducted by [redacted] and STATINTL will commence on 4 November 1962 for WRSP IV personnel. Upon their conclusion, D.M. personnel will be scheduled.

FUTURE ACTION - Recipients of this memo are invited to contact and inform Ed [redacted] or any significant information, results or recommended changes to provide a central clearing house for the LOX system.

STATINTL

MISCELLANEOUS

STATINTL 1. [redacted] presented a new product drawing of a portable LOX purge unit which eliminates the need for numerous, heavy gaseous cylinders.

STATINTL 2. [redacted] recommended the use of filters in the check valves and provided several modified units for design group consideration and test.

STATINTL

STATINTL

GCF:LES:tec

cc: [redacted]

File

Atch 152

SECURITY CLASSIFICATION

S E C R E T

LIFE SUPPORT

Date 22 NOV 1968

OIC

Asst

Mod

P.E.

Surv

TYPE MSG

BOOK

MULTI

SINGLE

PRECEDENCE

ACTION

PRIORITY

INFO

PRIORITY

DTG

25X1

FROM:

TO:

INFO:

7727

IDEALIST DM-3, SPO

SUBJ: LOX PROBLEMS.

1. UNTIL WE RECEIVE REVISED TECH DATA, [ ] REQUIRES THE ANSWERS TO THE FOLLOWING SPECIFIC QUESTIONS:

A. IF A LOX SYSTEM IS AUDIBLY VENTING PRIOR TO FLIGHT, HOW LONG SHOULD IT BE ALLOWED TO VENT BEFORE TAKING MAINTENANCE ACTION? WHAT ACTION, IF ANY, SHOULD THEN BE TAKEN? IF VENTING CONTINUES, IS THIS CAUSE FOR GROUND ABORT?

25X1 B. IS A SYSTEM LOW PRESSURE INDICATION IN FLIGHT (WARNING LIGHT, [ ], AND/OR LOW GAGE READING) CAUSE FOR AIR ABORT?

C. WHAT IS THE MINIMUM LOX QUANTITY ALLOWABLE PRIOR TO TAKEOFF ON A TURNAROUND FLIGHT?

2. REQUEST PROMPT ANSWERS TO ABOVE. WE HAVE HAD BOTH HIGH AND LOW PRESSURE INSTANCES IN THE PAST WEEK.

END OF MSG

25X1

25X1

DATE

22

TIME

0730L

MONTH

NOV

YEAR

68

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DIRECTOR OF MATERIEL

SECURITY CLASSIFICATION

S E C R E T

REGARDING INSTRUCTIONS

GP-1

DD FORM 173  
1 NOV 63

REPLACES EDITION OF 1 MAY 65 WHICH MAY BE USED

★ U.S. GOVERNMENT PRINTING OFFICE: ★ 1960: 281-011

S E C R E T

IN 30730

TOR: 27/0101Z NOV 68 DES

LIFE SUPPORT	
Date 7 NOV 1968	
OIC	<i>MM</i>
Asst	
Eng	<i>LP</i>
Med	
Food	

25X1 S E C R E T 262306Z NOV 68 CITE [ ] 1573 25X1

25X1 IDEALIST/[ ]/DM-3/ SPO

25X1 REF: [ ], DTD 22 NOV 68 (OUT 55385)

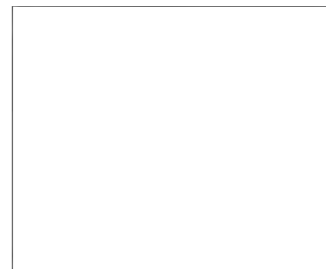
SUBJECT: LOX PROBLEMS

A. IF LOX SYSTEM IS AUDIBLY VENTING PRIOR TO FLIGHT:

1. SHUT OFF USAGE AT COCKPIT CONTROL PANEL AND WAIT 5 MINUTES FOR PRESSURE TO STABILIZE. VENTING SHOULD BECOME INAUDIBLE AND PRESSURE STABILIZE AT ABOUT 110 PSI. MAKE REGULAR PREFLIGHT CHECK.
2. IF AUDIBLE VENTING CONTINUES, ATTACH VENTING TOOL OT3340-1 TO FILL VALVE AND REDUCE PRESSURE TO ABOUT 25 PSI BUT NO LESS THAN 5 PSI. AUDIBLE VENTING SHOULD CEASE WITHIN A FEW SECONDS. REMOVE VENTING TOOL. PRESSURE SHOULD BUILD UP TO AT LEAST 80 PSI WITHIN 5 MINUTES. PRESSURE MAY GO TO RELIEF VALVE SETTING OF 100-120 PSI AND VENT. IF AUDIBLE, VENTING SHOULD BECOME INAUDIBLE WITHIN 1 MINUTE. MAKE REGULAR PREFLIGHT CHECK.

IN 30730

S E C R E T



*Atch 17*

*Lox phot.*



25X1 PAGE 2   1573 S E C R E T

3. IF AUDIBLE VENTING CONTINUES, DRAIN AND HOT PURGE THE SYSTEM. MAKE REGULAR OPERATIONAL CHECK-OUT.
- B. LOW PRESSURE INDICATION IS NO CAUSE FOR AIR ABORT UNLESS PRESSURE DROPS TO ZERO. PRESSURE WILL NOT STABILIZE BELOW 55 PSI; PRESSURE WILL CONTINUE TO DROP OR RECOVER ON CONTINUED BREATHING. PRESSURE SHOULD RECOVER TO NORMAL PRESSURE BAND OF 50-100 PSI WITHIN 30 SECONDS.
- C. CRITERIA FOR MINIMUM QUANTITY ON TURNAROUND IS TO ASSURE NO LESS THAN 2 LITERS IN A SYSTEM AT THE CONCLUSION OF A FLIGHT. NORMAL AVERAGE USAGE RATE OF LOX IS ONE HALF LITER PER HOUR FOR BOTH SYSTEMS. ASSUME SAME USAGE RATE OF LOX FOR CONSERVATING COMPUTATION OF MINIMUM QUANTITY FOR ONE SYSTEM, OR 1 LITER OF LOX FOR 2 HOURS OF FLIGHT.

END OF MSG

IN 30730

S E C R E T

Atch 17<sup>2</sup>

LS

S E C R E T

IN 31068  
TOR 12/1619Z DEC 68 JMP



LIFE SUPPORT	
Date	12 DEC 1968
OIC	<i>[Signature]</i>
Asst	<i>[Signature]</i>
Mod	<i>[Signature]</i>
Surv	<i>[Signature]</i>

25X1 S E C R E T 12/0018Z DEC 68 CITE [ ] 1704 25X1

25X1 [ ]  
IDEALIST/[ ]/SPO

SUBJECT: LOX SYSTEM

25X1 RECENT PROBLEMS IN THE LOX SYSTEM AT [ ] APPEAR TO  
25X1 BE CAUSED BY CONTAMINATION. 25X1

25X1 [ ] RECOMMENDS THAT A MEETING BE HELD THE WEEK  
25X1 OF 16-20 DECEMBER AT [ ] TO INVESTIGATE METHODS  
OF ELIMINATING OR REDUCING THE CONTAMINATION EFFECT ON  
25X1 THE SYSTEM AND THAT CORRECTIVE ACTION BE INITIATED  
IMMEDIATELY.

25X1 [ ] STRONGLY RECOMMENDS THAT A LOX EXPERT FROM  
WRIGHT-PATTERSON, FAMILIAR WITH LOX SYSTEMS ON USAF  
AIRCRAFT, BE INCLUDED AS AN ATTENDEE AT THIS MEETING  
AND BE PERMITTED TO EXAMINE THE LOX INSTALLATION IN  
THE U-2R.

END OF MSG.

Atch 18

LOX 1206

S E C R E T

IN 31272

TOR: 19/1854Z DEC 68 WP

LIFE SUPPORT	
DEC 16 DEC 1968	
OIC	<i>[Signature]</i>
Asst	
Med	
P.E.	<i>[Signature]</i>
Surv	

S E C R E T 191820Z DEC 68 CITE [ ] 1780

IDEALIST [ ]

REF : [ ] 8646, DTD 16 DEC 68 (IN 31150)

SUBJ: LOX SYSTEM

THE CHECK VALVE IN THE LOX CONVERTER APPEARS TO BE THE PRINCIPAL SOURCE OF TROUBLE IN BOTH THE LOW OXYGEN PRESSURE NOTED BY THE PILOTS AND THE VERY RAPID DEPLETION OF LOX NOTED AT OTHER TIMES.

THIS VALVE HAS VERY CLOSE DIAMETRAL CLEARANCE, AND ANY CONTAMINATION MAY CAUSE THE POPPET TO STICK IN THE OPEN OR CLOSED POSITION. THE CLOSE CLEARANCE IS NOT REQUIRED FOR SATISFACTORY POPPET OPERATION.

[ ] IS MAKING REPLACEMENT POPPETS WITH REDUCED DIAMETER LANDS AT EACH END AND ADDITIONAL RELIEF IN BETWEEN. THE LANDS WILL PROVIDE ADEQUATE GUIDE FOR THE POPPET TO INSURE PROPER OPERATION AND SEALING.

THIS CHANGE WAS DISCUSSED WITH [ ] ENGINEERS, WITH CONCURRENCE THAT THIS CHANGE WOULD CONSIDERABLY REDUCE THE SENSITIVITY OF THE VALVE TO CONTAMINATION. [ ] WILL FURNISH TWO NEW POPPETS TO [ ] AS SOON AS AVAILABLE. [ ] ALSO PROPOSES TO TEST THE VALVE IN BURBANK.

END OF MSG

IN 31272

S E C R E T

## SECURITY CLASSIFICATION

S E C R E T

TYPE MSG

BOOK

MULTI

SINGLE

## PRECEDENCE

ACTION

ROUTINE

INFO

25X1

FROM:

DTG

8150

25X1

TO:

IDEALIST R&amp;D

DM

SUBJECT: LOX BRIEFING

25X1 1. THIS PROPOSAL HAS BEEN INFORMALLY DISCUSSED WITH

25X1

2. PERSONNEL, DRIVERS, SUPERVISORS AND OTHERS

CONCERNED WITH OUR U-2R LOX PROBLEMS SHOULD BE PROVIDED A BRIEF-  
ING ON THE NEW FIXES BEING INITIATED BY LAC. THE MOST LOGICAL  
AND QUALIFIED PERSON TO PROVIDE THIS BRIEFING IS

25X1 3. REQUEST AUTHORITY FOR TO DEAL DIRECTLY WITH MR

IN SETTING UP THIS BRIEFING, I.E., DATA TO BE PRESENTED,  
DATES, TIMES, ETC.

END OF MESSAGE

## SPECIAL INSTRUCTIONS

LS

25X1

DATE	TIME
23	
MONTH	YEAR
DEC	68
PAGE NO	NO OF PAGES
1	1

D  
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TYPED NAME AND TITLE

PHONE

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R

SIGNATURE

25X1

TYPED (or stamped) NAME AND TITLE

USAF 25X1

Commander

SECURITY CLASSIFICATION

S E C R E T

REGRADING INSTRUCTIONS

GP-1

Atch 20

DD FORM 173  
NOV 63

REPLACES EDITION OF 1 MAY 65 WHICH MAY BE USED

U.S. GOVERNMENT PRINTING OFFICE: 1963 O 351-011

LOX PROB

SECURITY CLASSIFICATION			
SECRET			
TYPE MSG	BOOK	MULTI	SINGLE
			X
PRECEDENCE			
ACTION PRIORITY			
INFO			

DTG 5-14-7

25X1

FROM:

TO:

IDEALIST SWAP SHOP X

FOR GEN BOSS FROM 25X1

SUBJECT: RECAP FOR SWAP SHOP X

1. LOX: PROPOSE FOLLOWING EXCEPT FOR LOX TEST ARTICLES.

A. REPLACE NEW LOX VALVES WITH OLD LOX VALVES. REASON - IT APPEARS THAT NEW VALVES MAY NOT BE BUILT TO PROPER SPECS.

B. USE VENT INSTEAD OF BUILD-UP PROCEDURES.

COMMENT: THIS WILL PROBABLY BE TEMPORARY AS MOST PEOPLE DO NOT APPROVE, BUT IT WORKS BETTER FOR SAC.

C. SERVICE 4 - 6 HOURS PRIOR TAKE OFF.

D. HOT PURGE AT LEAST EVERY 25 SERVICINGS.

E. CONTINUE ABOVE UNTIL LAC DEVELOPES NEW AND PROVEN SYSTEM.

2. ABORT CRITERIA SHOULD BE:

A. LOX LOW PRESSURE SYMPTOMS: PRESS ON WITH TRANSIENT LOW PRESSURE EXCURSIONS. SHOULD THESE EXCURSIONS BECOME

25X1

LIFE SUPPORT	
Date	10 JAN 1969
OIC	<i>[Signature]</i>
Asst	<i>[Signature]</i>
Med	<i>[Signature]</i>
P.E.	<i>[Signature]</i>
Surv	<i>[Signature]</i>

SPECIAL INSTRUCTIONS

DATE	TIME
10	0900L
MONTH	YEAR
JAN	1969
PAGE NO.	NO. OF PAGES
1	3

D R A F T E R	TYPED NAME AND TITLE	PHONE	R E L E A S E R	SIGNATURE
	25X1 <i>[Signature]</i> /FBR	<i>[Signature]</i>		<i>[Signature]</i>
SECURITY CLASSIFICATION			RE	25X1
SECRET			CB-1	25X1

DD FORM 1 NOV 63 173

REPLACES EDITION OF 1 MAY 55 WHICH MAY BE USED

★ U.S. GOVERNMENT PRINTING OFFICE: GPO, 1969, 221-511

LOX

SECRET

PRECEDENCE	RAISED BY	DRAFTED	PHONE
ACTION INFO	PRIORITY	Same	25X1

25X1

EXCESSIVE (3 PER HOUR) THE PILOT WILL DESCEND TO 45,000 PLUS OR MINUS 2,000. IF PRESSURE DROPS TO ZERO AND STAYS, PILOT DESCENDS TO 45,000 PLUS OR MINUS 2,000. IN EITHER CASE SHOULD THIS TAKE PLACE PRIOR TO HALF WAY POINT, WE RETURN TO DEPARTURE POINT. IF THIS HAPPENS AFTER HALF WAY POINT, WE PRESS ON AT 45,000-7 PLUS OR MINUS 2,000.

B. BOTH LOX SYSTEMS MALFUNCTION: IN THIS CASE PILOT DESCENDS (MAX DESCENT PROCEDURES FROM CRUISE ALT, OR NORMAL DESCENT PROCEDURES FROM 45,000) TO APPROX 20,000 (CABIN ALT APPROX 10,000) AND PROCEEDS NEAREST DIVERSION FIELD.

3. HIGH PRESSURE SYMPTOMS: SHOULD PILOT NOTE A PRESSURE BUILD UP TO EXTENT HE CONSIDERS LIKELY TO LOSE PRESSURE, HE CONTINUES TO PRESS ON UNTIL THE SYSTEM QUANTITY DROPS TO TWO LITERS. HE THEN DESCENDS TO 45,000 PLUS OR MINUS 2,000. IF THIS HAPPENS PRIOR TO HALF WAY POINT, PILOT RETURNS TO DEPARTURE POINT. IF IT HAPPENS AFTER HALF WAY POINT, PILOT PASSES ON.

4. AUTO PILOT EXCELLENT FOR FERRY, BUT NEEDS IMPROVEMENT FOR FLIGHT LINE WORK.

5. H.F. FIXES LOOKS VERY GOOD ON THE GROUND. NINETY PERCENT CERTAIN THAT WE ARE OKKY HERE.

ILLEGIB

6. ADF PROBLEMS NOT SOLVED. ADF NOT A SWAP-SHOP X FERRY REQUIREMENT AS IT WOULD BE IN SOME AREAS OF THE WORLD. REQUEST ☐ WAIVE THIS ITEM AS AN ABORT ITEM FOR SWAP SHOP X. LAC CAN CONTINUE WITH

25X1

CONTROL NO	TOR/100	PAGE NO.	NO OF PAGES	MESSAGE IDENTIFICATION	INITIALS
		2	3		
SECURITY CLASSIFICATION			REGRAIDING INSTRUCTIONS		
SECRET			GP-1		

Atch 212

DD FORM 173-1

REPLACES EDITION OF 1 MAY 55 WHICH MAY BE USED.

~~SECRET~~ SECRET

25X1

25X1

25X1

PRECEDENCE	RELEASED BY	DRAFTED BY	PHONE
ACTION FO PRIORITY			

FOLLOW-ON WORK AFTER DELIVERY OF 057.

7. SUMMARY: ALTHOUGH 057 IS NOT IN AS GOOD CONDITION AS I WOULD  
LIKE, RECOMMEND THAT WE PROCEED WITH SWAP SHOP X AS PLANNED. THE  
ABORT PLAN NOTED ABOVE IS CALCULATED AND IS CONSIDERED SAFE.

END OF MSG

CONTROL NO.	TOR/TOD	PAGE NO. 3	NO OF PAGES 3	MESSAGE IDENTIFICATION	INITIALS
SECURITY CLASSIFICATION SECRET			REGRADING INSTRUCTIONS GP-1		

*Atch 21<sup>3</sup>*

DD FORM 173-1  
1 NOV 63

REPLACES EDITION OF 1 MAY 55 WHICH MAY BE USED.

S E C R E T

IN 32061  
TOR 22/1909Z JAN 69 JMP

LIFE SCHEDULE	
Date	22 JAN 1969
OTC	
Asst	
Eng	
Plt	
Ref	

→

25X1 S E C R E T 221721Z JAN 69 CITE  9659 25X1

25X1 IDEALIST  DM-1

SUBJECT: LOX PROCEDURES

1. THE FOLLOWING HEADQUARTERS APPROVED LOX SERVICING  
PROCEDURES WILL BE UTILIZED BY  25X1

A. LOX SYSTEMS WILL BE LEFT IN "VENT" POSITION WHILE  
ARTICLES ARE ON THE GROUND. .!!

B. 4 TO 6 HOURS PRIOR TO SCHEDULED TAKE-OFF SYSTEMS  
WILL BE SERVICED AND SYSTEMS LEFT IN "VENT" POSITION.

C. APPROXIMATELY 1:30 HOURS PRIOR TO TAKE-OFF LOX  
SYSTEMS WILL BE PLACED IN "BUILT-UP" POSITION.

2. IT IS ANTICIPATED THAT IN THE NEAR FUTURE APPROPRIATE  
CHANGES WHERE NECESSARY WILL BE MADE TO THE HARD COPY TECH  
DATA AFTER FINAL ACCEPTANCE OF LOX SYSTEMS HARDWARE THAT  
MEETS THE REQUIREMENTS OF OUR MISSION.

END OF MSG

IN 32361

S E C R E T

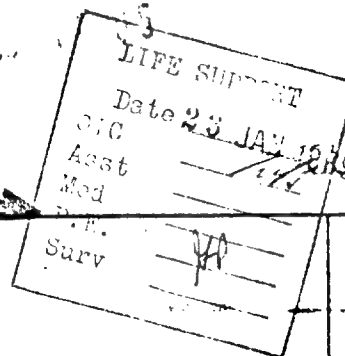
Attch 22

Lox Plan



SECURITY CLASSIFICATION			
SECRET			
TYPE MSG	BOOK	MULTI	SINGLE
PRECEDENCE			
ACTION	PRIORITY		
INFO	ROUTINE		

DTG



25X1

FROM:

25X1

TO:

IDEALIST DM-1,3

REF:  9659 (IN 32061) 22 JAN 69

SUBJ: LOX PROCEDURES

1. REQUEST CLARIFICATION OF REF IN VIEW OF PROCEDURAL  
25X1

EXERCISES PRESENTLY IN PROGRESS AT .

2. TO REVIEW, ART 058 IS BEING HANDLED AS DESCRIBED IN REF.

053 IS STILL SIMULATING WHAT IS GENERALLY DESCRIBED AS QUOTE  
SAC PROCEDURES UNQUOTE; I.E., IN BUILD-UP UNTIL 4-6 HOURS PRIOR  
TO LAUNCH, AT WHICH TIME IT IS SERVICED AND LEFT IN VENT UNTIL  
SHORTLY BEFORE TAKEOFF. 055 IS BEING HANDLED AS PRESCRIBED IN  
LAC TECH DATA. INCIDENTALLY, WE ARE HAVING NO LOW PRESSURE  
PROBLEMS WITH ANY OF THE THREE.

3. SUGGEST THAT ADOPTING REF PROCEDURES FOR ALL THREE  
ARTICLES WILL PRECLUDE GATHERING OF WHAT COULD BE VALUABLE  
COMPARATIVE DATA, AS WELL AS INTERRUPTING LAC TEST CONTINUITY  
IN 055.

4. PLEASE ADVISE.

SPECIAL INSTRUCTIONS

DATE	TIME
23	0800
MONTH	YEAR
JAN	69
PAGE NO.	NO. OF PAGES
1	1

D R A F T E R	TYPED NAME AND TITLE		END OF MESSAGE	R E L E A S E R	<input type="text"/> DIRECTOR OF MATERIAL REGRADING INSTRUCTIONS GP-1	25X1
	25X1	25X1	PHONE <input type="text"/>			
SECURITY CLASSIFICATION			GP-1			
SECRET			GP-1			

DD FORM 173

1 NOV. 63

REPLACES EDITION OF 1 MAY 55 WHICH MAY BE USED.

☆ GPO 1969-271-555

LOX

SECRET

IN 32120

TOR 23/2149Z JAN 69 EWM

→

Assnt	
Mod	
P.E.	
Surv	

23 JAN 1969

SECRET 232109Z JAN 69 CITE [ ] 9717

25X1

PRIORITY [ ]

IDEALIST

REF: A. [ ] 9669 22 JAN 69 (IN 32067)

B. [ ] 8673 23 JAN 69 (OUT 56333)

PROCEDURES STATED IN REFERENCE A ARE CONSTRUED TO MEAN THAT THIS IS THE STANDARD PROCEDURE UNDER NORMAL CONDITIONS THAT WILL BE USED BY [ ] PENDING FINAL DETERMINATION AND RESOLUTION OF BOTH EQUIPMENT AND PROCEDURES PROGRAMMED PER MEETING SCHEDULED [ ] 28 JANUARY 1969. PREVIOUS CONCURRENCE AND AGREEMENTS BETWEEN THIS HEADQUARTERS AND [ ] WERE MADE AND STILL APPLY RELATIVE TO ARTICLES 053 AND 055. REQUEST [ ] BE PREPARED TO BRIEF IN DETAIL RESULTS OF THE TESTS BEING PERFORMED ON THESE THREE ARTICLES TO INCLUDE ALL IN FLIGHT WRITE-UPS, GROUND OPERATION PROBLEMS ENCOUNTERED, DETAILS PERTAINING TO ANY HARDWARD CHANGES, ACCUMULATED HOURS OF OPERATION BOTH GROUND AND AIR ON INSTALLED HARDWARE, ETC. IN EACH CASE. IT IS HOPED THAT THIS DATA IN CONJUNCTION WITH THE DATA PREPOTEDLY TO BE AVAILABLE BY [ ], ACCUMULATED FROM THE TEST FLIGHT

IN 32120

SECRET

Atch ~~23~~ 24'  
10V

ACTIVITY WITH THE MODIFIED CONVERTER, WILL ASSIST IN THE FINAL  
RESOLUTION OF EITHER THE INHERENT OR SELF-IMPOSED PROBLEMS WE  
HAVE EXPERIENCED IN THE LAST 30 DAYS WITH THE LOX SYSTEMS IN THE  
"R" MODEL AIRCRAFT.

END OF MSG

IN 32121

SECRET

*Atch ~~21~~ 24<sup>2</sup>*

SECRET

IN 32079

TOR 22/2226Z JAN 69 CWM

LIFE SUPPORT  
Date 23 JAN 1969  
OIC [Signature]  
Asst [Signature]  
Sgt [Signature]  
Sgt [Signature]

SECRET 222206Z JAN 69 CITE [ ] 9682

25X1

PRIORITY [ ]

25X1

IDEALIST [ ]/SPO

25X1

SUBJECT: LOX CONFERENCE

1. REFERENCE TELECON THIS DATE BETWEEN [ ]

25X1

FOLLOWING SUGGESTION IS SUBMITTED FOR YOUR CONCURRENCE. A

MEETING BE SCHEDULED AT [ ] 28 JANUARY 1969 WITH REPRESENTATIVES  
FROM PROJECT HEADQUARTERS, [ ], IF

25X1

AVAILABLE. THE PURPOSE BEING TO REVIEW IN DEPTH THE PRESENT  
LOX SYSTEMS IN TEST BY LAC WITH THE HOPE THAT A FINAL DETERMINATION  
AND DECISION CAN BE MADE RELATIVE TO THE BUY OF THIS SYSTEM, IF  
PROVEN SATISFACTORY, AND THE DEVELOPMENT OF THE NECESSARY HARD  
COPY PROCEDURES TO BE UTILIZED WITH THIS SYSTEM IN THE U-2R  
MODEL AIRCRAFT. PARTICIPANTS FROM HEADQUARTERS WILL BE [ ]  
AND [ ].

25X1

2. FOR [ ] - IT IS ASSUMED THAT YOU WOULD ALSO LIKE TO  
PARTICIPATE IN THIS MEETING AND IF SO DESIRE ARE WELCOME TO  
ATTEND.

25X1

END OF MSG

IN 32079

SECRET

Atch 25  
104

SECRET

IN 32111

TOR 23/2123Z JAN 69 EWM

LIFE SUPPORT	
Date	23 JAN 1969
OIC	<i>[Signature]</i>
Asst	<i>[Signature]</i>
Med	<i>[Signature]</i>
P.E.	<i>[Signature]</i>
Surv	<i>[Signature]</i>

SECRET 232003Z JAN 69 CITE  9786

IDEALIST

SUBJECT: U-2R OXYGEN SYSTEM

REF:  2069 (NOT SENT ABAFT) (IN 32048)

1. AT THE COMPLETION OF 50 HOURS OF SUCCESSFUL IN-FLIGHT OPERATION OF THE MODIFIED OXYGEN SYSTEM,  REQUESTS THAT THE FOLLOWING INFORMATION BE PROVIDED CONCURRENTLY WITH  RECOMMENDATIONS:

A. COMPLETE LOX PRESSURE AND QUANTITY VERSUS TIME DATA FOR EACH TEST FLIGHT. ASSOCIATED INFORMATION REGARDING SERVICING (I.E., HOW LONG BEFORE FLIGHT WAS SYSTEM SERVICED? WAS IT LEFT IN BUILD-UP OR VENT BETWEEN FLIGHTS? DID THE SYSTEM REQUIRE HIGH FLOWS AT COCKPIT OR SYSTEM VENTING PRIOR TO FLIGHT TO REDUCE HEAD PRESSURE?) AND PILOT DATA (I.E., WHICH PILOT? WHAT TYPE SUIT WAS USED?) SHOULD BE INCLUDED.

B. DATA OBTAINED FROM ALL BENCH TESTS. SPECIFICALLY, HOW DOES SYSTEM REACT TO PERIODS OF HIGH FLOW (UP TO 90 LPM) OR LOW FLOW (10 LPM OR LESS). HOW LONG BEFORE LIQUID

IN 32111

SECRET

*Attch 26' Cox*

ENTERS PILOT CONSOLE AT HIGH FLOWS? DOES A PERIOD OF LOW DEMAND FOLLOWING A PERIOD OF HIGH FLOW RESULT IN ABNORMAL PRESSURES?

C. FAILURE ANALYSES DATA IS DESIRED AND APPROPRIATE TESTING IS REQUESTED TO OBTAIN INFORMATION ON SYSTEM PERFORMANCE WITH FAILURE OF THE RELIEF VALVE (FAILED OPEN TO DEGREES RANGING FROM LOW LEAKAGE THROUGH MAXIMUM RELIEF VALVE FLOW), AND FAILURE OF THE PRESSURE CONTROL VALVE (FAILED OPEN). IN SUCH INVESTIGATIONS, REALISTIC SIMULATION OF NORMAL DEMAND ON THE SYSTEM SHOULD BE EMPLOYED. DATA OF PRIMARY CONCERN IS HOW THE PILOT WILL DETECT A GIVEN FAILURE AND WHAT THE TIME FACTOR IS FOR A GIVEN FAILURE (I.E., TIME TO REACH ZERO PRESSURE OR QUANTITY).

2. ASIDE FROM THE MODIFIED SYSTEM, SOME BASIC QUESTIONS REMAIN PERPLEXINGLY UNANSWERED REGARDING OUR LOX PROBLEMS TO DATE. IF POSSIBLE, IT IS REQUESTED THAT ☐ ATTEMPT TO CLEAR UP THESE QUESTIONS ALONG WITH THE ABOVE REQUESTED INFORMATION.

A. THE MAJORITY OF OUR PAST LOX PROBLEMS CAN BE EXPLAINED ON THE BASIS OF FAILURE OF THE CHECK VALVE TO FUNCTION PROPERLY. THIS LED TO A REDESIGN OF THE CHECK VALVE BY

Atch 26<sup>2</sup>

25X1

25X1

[ ] INITIALLY AND NOW TO ELIMINATION OF THE CHECK VALVE ENTIRELY. HOWEVER, [ ] HAS SUPPLIED LOX COMPONENTS FOR ALL SR-71 AND RELATED AIRCRAFT WHICH ARE IDENTICAL, INCLUDING THE CHECK VALVE, TO THE U-2R COMPONENTS AND THERE HAS BEEN APPARENTLY NO SIMILAR DIFFICULTIES ENCOUNTERED IN THESE PROGRAMS. IN ADDITIONS, OVER 3,000 RELATED ASSEMBLIES ARE IN USE IN OTHER USN AND USAF AIRCRAFT. CAN THE DIFFERENCES IN FLIGHT ENVIRONMENT READILY EXPLAIN THE DIFFERENCE IN CHECK VALVE PERFORMANCE BETWEEN THE U-2R AND OTHER AIRCRAFT CONSIDERING THAT THE CHECK VALVE IS PASSING LIQUID OXYGEN AT MINUS 297 DEGREES F?

B. IF ENVIRONMENTAL FACTORS DO NOT ACCOUNT FOR OUR APPARENT CHECK VALVE MALFUNCTIONS, CAN CONTAMINATION BE THE BASIC PROBLEM? MOISTURE SHOULD NOT BE A FACTOR CONSIDERING THE PURGE PROCEDURES NOW EMPLOYED. CONTAMINATION HAS NOT BEEN DETECTED IN LOX SAMPLES TAKEN FROM STORAGE TANKS, SERVICE CARTS OR CONVERTERS THEMSELVES. HOWEVER, IF PARTICULATE CONTAMINATION IS PRESENT IN SOME OF OUR CONVERTERS, WHAT WILL BE THE EFFECT OF CHECK VALVE REMOVAL? WILL WE EXPECT TO SEE PRESSURE CONTROL VALVE

Atch 26<sup>3</sup>

FAILURES AS PARTICULATE MATTER MOVES THROUGH THE BUILD UP  
CIRCUIT, OR WILL CONTAMINATION BECOME UNIMPORTANT WITH  
RESPECT TO MALFUNCTIONS?

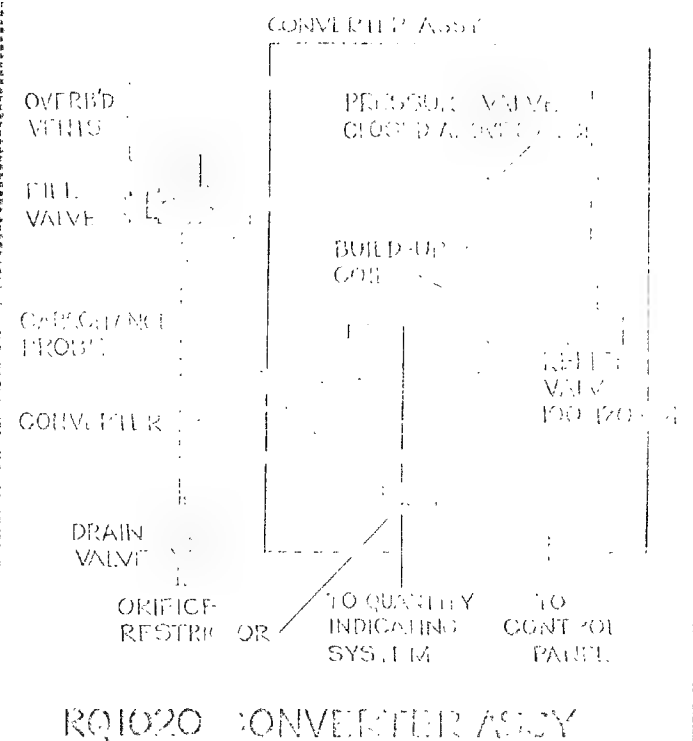
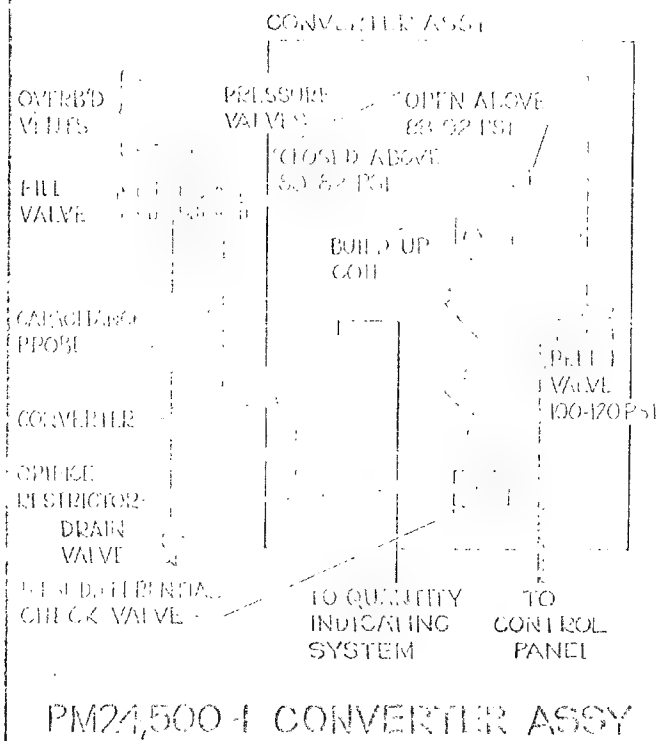
25X1 3. IT IS APPRECIATED THAT SOME OF THE ABOVE QUESTIONS WOULD  
REQUIRE EXTENSIVE RESEARCH BEFORE FINAL ANSWERS COULD BE OBTAINED,  
AND IT IS NOT   INTENTION TO DELAY OBTAINING A TROUBLE-FREE  
OXYGEN SYSTEM. HOWEVER, WITH EACH PAST ATTEMPT THAT FAILED TO SOLVE  
THE LOX PROBLEMS, A REDUCED CONFIDENCE LEVEL IN THE SYSTEM ON THE  
PART OF THE PILOTS AND OTHER CONCERNED PARTIES WAS INCURRED. THEREFORE,  
ANSWERS TO QUESTIONS SUCH AS THOSE POSED ABOVE ARE NOW AS IMPORTANT  
AS PROPOSED FIXES IN RESTORING OR ATTAINING CONFIDENCE, AND SHOULD  
BE DISCUSSED AT 28 JAN 69 LOX CONFERENCE.

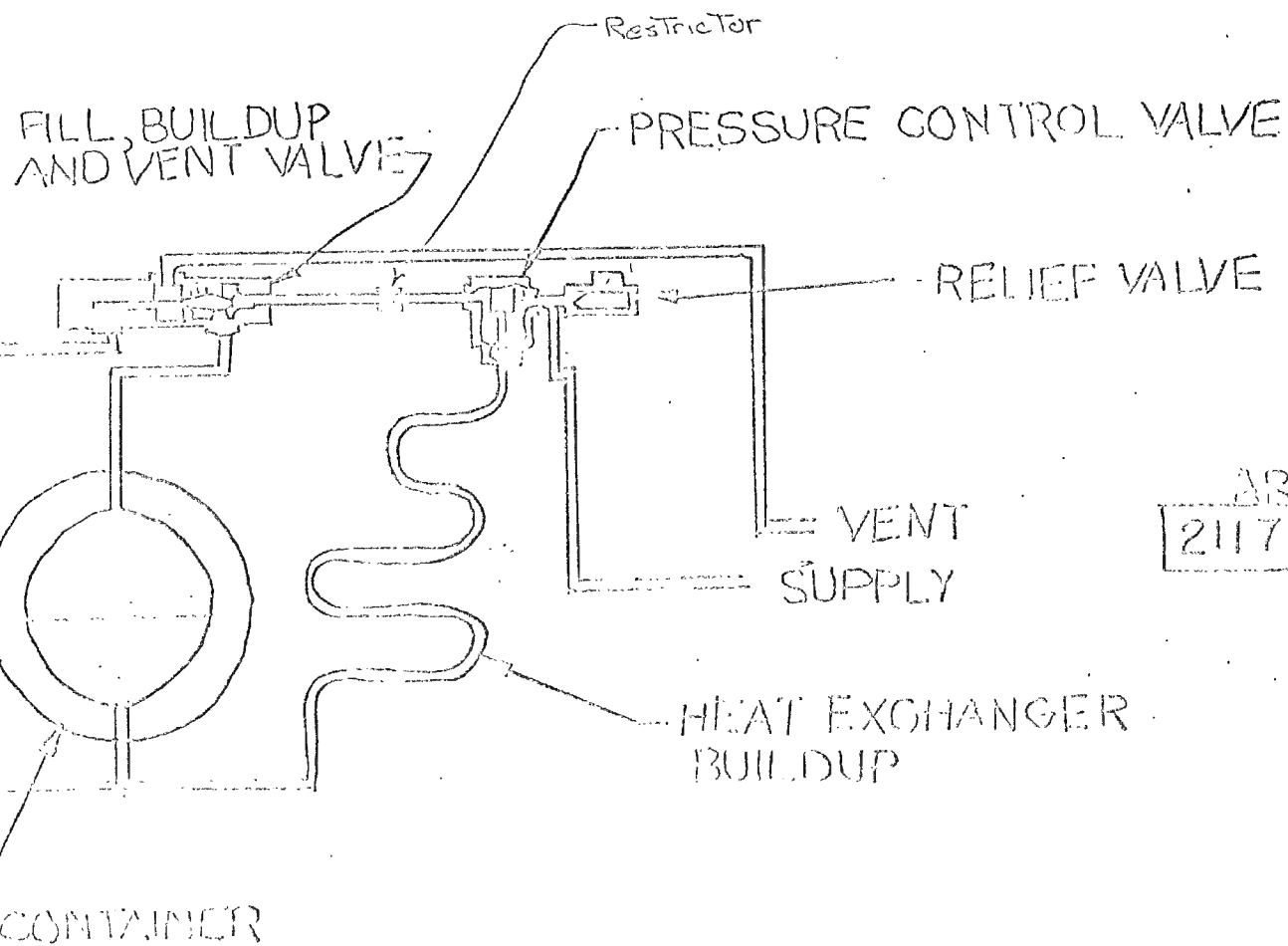
END OF MSG

*Atch 264*

SECRET





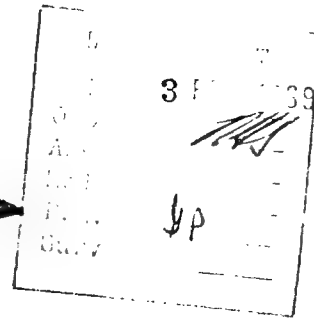


ASO  
[21170-11]

SCHEMATIC

March 28

SECRET



IN 32391

TOR 01/1853Z FEB 69 EWM

SECRET 312339Z JAN 69 CITE  9971

25X1

PRIORITY

IDEALIST

SUBJECT: LOX PROCEDURES

1.  RESEARCH OF USAF PROCEDURES INDICATES PRESENT U-2R TECH DATA REGARDING SERVICING OF LOX SYSTEM SHOULD ALSO BE USED FOR THE MODIFIED SYSTEM. SPECIFICALLY, ONCE INSTALLED, THE MODIFIED SYSTEM SHOULD BE LEFT IN BUILD-UP AT ALL TIMES, WITH FILLING TO BE PERFORMED BETWEEN 1 AND 24 HOURS PRIOR TO A GIVEN FLIGHT.

2. INTERIM SERVICING PROCEDURES FOR UNMODIFIED SYSTEM (I.E., VENT POSITION BETWEEN FLIGHTS), AS DIRECTED BY  IN PREVIOUS MESSAGES, WILL REMAIN IN EFFECT UNTIL A GIVEN AIRCRAFT IS MODIFIED.

25X1

SECRET

IN 32391

SECRET

*Handwritten:* 29 LOX

**S E C R E T**

IN 32365

TOR 312104Z JAN 69 RLP

INFORM SUPPORT	
Date	3 FEB 1969
CIC	<i>[Signature]</i>
Asst	
Int	<i>[Signature]</i>
Plan	
Surv	

**S E C R E T** 312016Z JAN 69 CITE  9944

25X1

PRIORITY

NO NIGHT ACTION

IDEALIST

FOR

SUBJECT: LOX CONFERENCE AND SYSTEM 17B

1. THE FOLLOWING INFORMATION IS PROVIDED IN AN ATTEMPT TO UPDATE YOU ON THE RESULTS OF THE LOX CONFERENCE HELD AT  ON 28 JANUARY 1969. PROJECT HEADQUARTERS CONCURS IN PRINCIPLE WITH THE PROPOSED INSTALLATION OF THE MODIFIED LOX CONVERTER SYSTEM IN THE U-2R AT THE EARLIEST OPPORTUNITY. I HAVE IMPOSED A REQUIREMENT TO INSURE THAT APPROPRIATE TECH DATA IS, IN FACT, AVAILABLE PRIOR TO THE RETROFIT OF THE FLEET. THE TECH DATA TO BE ALL INCLUSIVE AND SPECIFICALLY IN THE AREA OF SERVICING PROCEDURES. IT IS ANTICIPATED THAT FINAL DETERMINATION BY INTERESTED PERSONNEL WILL BE HOPEFULLY FINALIZED THIS DATE.

25X1

TO PRECLUDE ANY MIXING OF CONFIGURATIONS AND INSURE THE AVAILABILITY OF APPROPRIATE TECH DATA,  HAS BEEN INSTRUCTED TO PREPARE FOR SHIPMENT, HOPEFULLY VIA SWAP SHOP XI, 5 EACH SETS OF HARDWARE FOR SUBSEQUENT INSTALLATION IN ARTICLES 057 AND 058

25X1

IN 32365

**S E C R E T**

PAGE 1 OF 2

*Atch 30'*

*Lox*

25X1 PAGE 2 [ ] 9944 S E C R E T

25X1 AFTER ARRIVAL YOUR STATION. I WILL LIKEWISE ATTEMPT TO HAVE IN BEING TO ACCOMPANY THIS HARDWARE THE PRELIMINARY PROCEDURAL TECH DATA. CERTAIN GRAPHS AND CHARTS THAT WERE A COMPILATION OF THE TESTS PERFORMED BY [ ] ON ARTICLE 055 WITH THE MODIFIED CONVERTERS WAS OBTAINED AND WILL BE PROVIDED TO YOU ON MY ARRIVAL. IN THE INTERIM ARTICLE 058 WILL ARRIVE IN THE SAME CONFIGURATION AS ARTICLE 057 AND APPLICABLE PROCEDURES PERTINENT WILL APPLY BOTH ARTS.

2. NEW SUBJECT - SYSTEM 17B - RESULTS REALIZED ON TWO FLIGHT TESTS OF SYSTEM 17B ON THE "R" MODEL HAVE NOT BEEN SATISFACTORY. FURTHER WORK AND FLIGHT TESTING IS NECESSARY BEFORE IT CAN BE CONSIDERED "OR" FOR OPERATIONAL REQUIREMENTS. SUBJECT SYSTEM WILL NOT ACCOMPANY ARTICLE 058 AND IT IS ANTICIPATED THAT APPROXIMATELY THREE WEEKS IS REQUIRED FOR FURTHER TESTING. SUBJECT NOSE AND EQUIPMENTS WILL BE SHIPPED YOUR STATION AFTER COMPLETION AND VERIFICATION THAT THE SYSTEM IS, IN FACT, OPERATIONAL.

END OF MSG

IN 32365

S E C R E T

*File 30<sup>2</sup>*  
FINAL PAGE OF 2

JOINT MESSAGEFORM		RESERVED FOR COMMUNICATION CENTER	
SECURITY CLASSIFICATION <b>SECRET</b>		LIFE SUPPORT Date <u>5 MAR 1969</u> OIC _____ Asst _____ Med _____ P.E. <u>90</u> Surv _____	
TYPE MSG	BOOK	MULTI	SINGLE
PRECEDENCE			
ACTION <u>ROUTINE</u>			
INFO			
25X1	FROM:	DTG 570 58 L5	
	TO:	9397 INFO:	
IDEALIST OPS R&D RM ESM/SPO		SPECIAL INSTRUCTIONS	
SUBJECT: U-2R LOX SYSTEM		DRAFT COORD WITH: 25X1	
1. AS PLANNED DURING THE LOX MEETING HELD AT [ ] 28 JAN 69, A [ ] BRIEFING TEAM MADE A PRESENTATION TO [ ] PERSONNEL ON 3 MARCH. BRIEFING TEAM CONSISTED OF [ ] AND [ ] ATTENDEES INCLUDED SIX DRIVERS PLUS REPRESENTATIVES FROM OPS, LIFE SUPPORT, MATERIEL, POLS ADDITIONAL INTERESTED PERSONS TOTALING ABOUT 35 IN NUMBER.		25X1	
2. SUBJECT MATTER CONSISTED OF A HISTORICAL REVIEW OF PROBLEMS AND SOLUTIONS INVOLVING THE LOX SYSTEM TESTS AND RESULTS UNDERTAKEN DURING THE STUDY, AND CHARTS DIAGRAMMING THE OLD AND THE NEW SYSTEMS TYPICAL CONSUMPTION RATES, AND A TYPICAL TIME/QUANTITY CURVE. HAND-OUTS WERE ESSENTIALLY THE SAME AS THOSE DISTRIBUTED DURING THE 23 JAN LOX MEETING MENTIONED ABOVE.		25X1	
3. [ ] ATTITUDE PRIOR TO THE BRIEFING WAS ONE OF SKEPTICISM AND LACK OF FULL CONFIDENCE IN THE SYSTEM. THIS FEELING OF DOUBT WAS MANIFESTED BY THE TYPE AND DEPTH OF QUESTIONS ASKED DURING AND		25X1	
DRAFT	TYPED NAME AND TITLE	PHONE	SIGNATURE
	[ ]	[ ]	[ ]
	[ ]		[ ]
SECURITY CLASSIFICATION <b>SECRET</b>		REGRAIDING INSTRUCTIONS 62-1 <u>Atch 31' LOX</u>	

DD FORM 173

NOV 63

REPLACES EDITION OF 1 MAY 55 WHICH MAY BE USED

★ U.S. GOVERNMENT PRINTING OFFICE: \*GPO: 1969: 551-911

ABBREVIATED INT MESSAGEFORM  
and/or CONTINUATION SHEET

SECURITY CLASSIFICATION

S E C R E T

25X1

PRECEDENCE	RELEASED BY	DRAFTED BY	PHONE
ROUTINE			
INFO			

AFTER THE BRIEFING BY ATTENDERS FROM ALL [ ] ACTIVITIES.

25X1

4. HOPEFULLY, THIS BRIEFING WOULD DISPEL ALL CONCERN ABOUT THE PRESENT LOX SYSTEM, BOTH FROM OPERATOR AND MAINTENANCE POINTS OF VIEW. THIS DESIRED OBJECTIVE WAS NOT ATTAINED. [ ] STILL FEELS THAT THE U-2R LOX SYSTEM AS PRESENTLY CONFIGURED IS ONLY marginally CAPABLE OF RELIABLY SUPPORTING THE U-2R MISSION.

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5. PARTICULAR CONCERN INVOLVES LENGTHS OF SORTIES THAT CAN BE SUPPORTED BY THIS SYSTEM. IN SOME CASES, IT APPEARS THAT THE LOX SYSTEM RATHER THAN FUEL CAPACITY OR ANY OTHER FACTOR WILL BE THE LIMITING PARAMETER FOR LONG RANGE MISSIONS. IN ADDITION, ALL PARTIES, INCLUDING THE BRIEFERS, ARE CONCERNED ABOUT THE USE OF PRESSURE RELIEF VALVE AS A PRESSURE REGULATING DEVICE. ONE AREA OF DRIVER SKEPTICISM INVOLVES THE RELIANCE A DRIVER DEEP IN DENIED TERRITORY CAN PLACE ON A RELAXED SYSTEM THAT SUDDENLY AND POSITIVELY MUST START SUPPLYING OXYGEN WHEN THE WORKING SYSTEM BECOMES DEPLETED.

6. IN SUMMARY, THEN, [ ] FEELS THAT THE PRESENT SYSTEM, IMPROVEMENT THAT IT IS, AND REGARDLESS OF HOW PROMISING ITS POTENTIAL SEEMED AT FIRST, IN FACT marginally FULFILLS THE REQUIREMENT. WE PROPOSE, THEREFORE, THAT A MEETING OF ALL CONCERNED BE CONVENED AT [ ] TO ALLOW US TO PRESENT OUR VIEWS, AND THE DATA UPON WHICH WE BASE OUR VIEWS. WE SUGGEST THAT THE MEETING BE HELD 18 MARCH 1969.

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7. REQUEST COMMENTS/CONCURRENCE.

END OF MESSAGE

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REPLACES EDITION OF 1 MAY 55 WHICH MAY BE USED.

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